State of Illinois
Department of Registration and Education
STATE GEOLOGICAL SURVEY DIVISION
John C. Frye, Chief

GUIDE LEAFLET

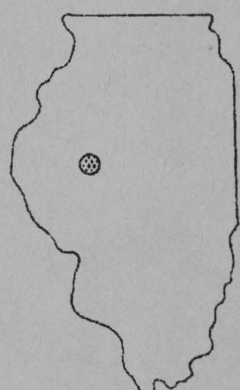
GEOLOGICAL SCIENCE FIELD TRIP

Sponsored by
ILLINOIS STATE GEOLOGICAL SURVEY, URBANA

HAVANA AREA

Fulton and Mason Counties

Havana, Chandlerville, Beardstown, and Vermont Quadrangles



Leaders
William Cote, David Reinertsen, and Myrna Killey
Urbana, Illinois
May 10, 1969

GUIDE LEAFLET 1969 B

HOST: Havana High School

TO THE PARTICIPANTS:

The Geological Science Field Trip program is designed to acquaint Illinois residents with the landscape, the rock and mineral resources, and the geological processes that have led to their origin. With this program, we hope to stimulate a general interest in the geology of Illinois and a greater appreciation of the state's vast mineral resources and their importance to the over-all economy.

We encourage you to ask the tour leaders any questions that may occur to you during the trip. Discussion often clarifies points that otherwise would remain confused to many of the participants. We also invite your written comments upon the conduct of the trips so that we might improve them as much as possible.

Additional copies of this guide leaflet, as well as itineraries for field trips that have been held in the past, may be obtained free of charge by writing to the Illinois State Geological Survey. The itinerary maps for each field trip can be purchased for 10 cents each.

Several of the stops along this itinerary are located on private property whose owners have graciously given us permission to visit their lands. Please obey the instructions of your trip leaders and conduct yourselves in a manner that will show respect for the property owners' cooperation. Please do not litter, or climb on fences, and leave all gates as found, so that we may be welcome to return on future field trips. These simple rules of courtesy also apply to public property as well. For the convenience of those persons who may use this itinerary at some future time, the names and addresses of every private property owner are listed for the respective stops on a page at the back of this guide leaflet. Whenever possible, always attempt to obtain permission when visiting private property.

We hope that you enjoy today's field trip and will attend others in the future.

THE STAFF
EDUCATIONAL EXTENSION SECTION
ILLINOIS STATE GEOLOGICAL SURVEY

HAVANA GEOLOGICAL SCIENCE FIELD TRIP

INTRODUCTION

The Havana area is situated physiographically within the Galesburg Plain, a region of deeply dissected (Illinoian) glacial plains. Narrow, gently undulating upland areas interspersed by a maze of deep, sharp valleys contrast with the flat expanses of Illinois Valley and Spoon Valley, its major tributary in this area. Illinois Valley is the most prominent topographic feature, and it is 17 to 20 miles wide in the vicinity of Havana. This portion of Illinois Valley forms part of the Havana Lowland, a broad, triangular alluvial lowland that extends from Pekin to Beardstown. On the northwest, the valley is bordered by steep, 80 to 150 foot high bluffs. East of the river, the valley bottom is covered by an extensive tract of sand ridges and dunes 20 to 40 feet high. Five terrace levels record events in the valley's complex history.

Geologically the field trip area is located on the northwest flank of the Illinois Basin, a great spoon-shaped, bedrock depression covering most of Illinois (fig. 1). Bedrock in the Havana area consists of approximately 4,500 feet of Paleozoic sedimentary rocks that range in age from late Cambrian (about 550 million years old) to middle Pennsylvanian (about 290 million years old). The Cambrian rocks rest on an ancient erosion surface on Precambrian granite that is more than 1 billion years old. The great thicknesses of sedimentary rocks in the basin, consisting of sandstone, shale, limestone, and coal, were deposited in the ancient, shallow seas and marshes that periodically covered Illinois and the Midwest during the Paleozoic Era.

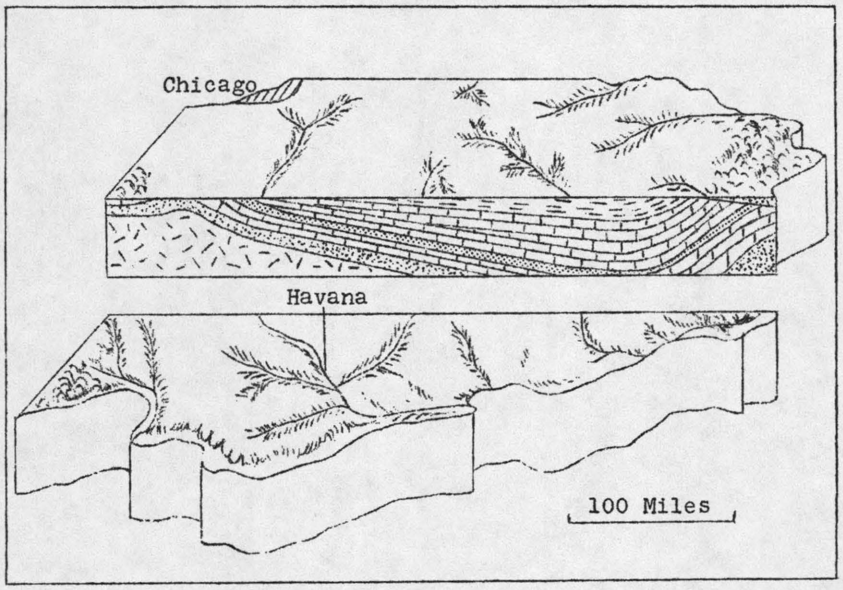
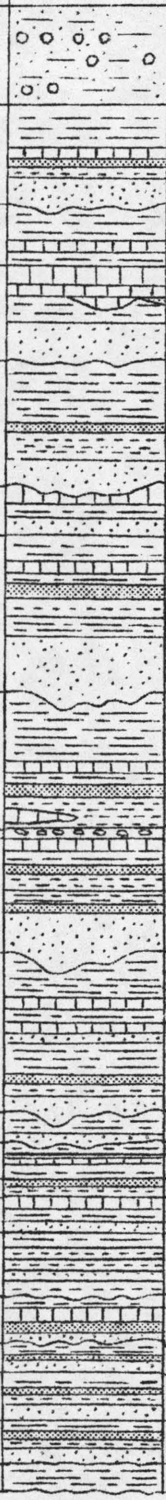


Fig. 1 - North-south cross-section through Illinois showing the Paleozoic strata in the Illinois Basin.

During deposition of the Paleozoic rocks, the Illinois Basin was a slowly sinking region much of the time, and it is now filled by more than 13,000 feet of sedimentary strata in its deepest part in southeastern Illinois. In the field trip area the strata are tilted gently downward to the southeast and gradually thicken into the basin. Bedrock exposures belong to the Pennsylvanian Spoon, and Carbondale Formations that were deposited about 300 to 290 million years ago (fig. 2). These strata contain several coal beds of great economic importance to west-central Illinois.

The Havana area was glaciated during the Nebraskan, Kansan, and Illinoian Stages of the Pleistocene Epoch of "Great Ice Age," which lasted from about 1,000,000 to 5,000 years ago. Glacial deposits completely mantle the bedrock surface to an



GROUP	FORMATION	CYCLOTHEM	THICKNESS	ROCK UNITS	MEMBERS
PLEISTOCENE			0-200		Outwash, till, terrace deposits
McLEANSBORO	MODESTO	Trivoli	37		Cramer Limestone Chapel (No. 8) Coal Trivoli Sandstone
McLEANSBORO	MODESTO		0-40		Exline Limestone
McLEANSBORO	MODESTO	Gimlet	15-69		Lonsdale Limestone Gimlet Sandstone
McLEANSBORO / KEWANEE	MODESTO / CARBONDALE	Sparland	8-80		Farmington Shale Danville (No. 7) Coal Copperas Creek Sandstone
KEWANEE	CARBONDALE	Jamestown	11-17		Pokeberry Limestone
KEWANEE	CARBONDALE	Brereton	15-102		Lawson Shale Brereton Limestone Herrin (No. 6) Coal Big Creek Shale Vermilionville Sandstone
KEWANEE	CARBONDALE	St. David	18-55		Canton Shale St. David Limestone Springfield (No. 5) Coal
KEWANEE	CARBONDALE	Summum	11-85		Covel Conglomerate Hanover Limestone Summum (No. 4) Coal Kerton Creek Coal Pleasantview Sandstone
KEWANEE	CARBONDALE / SPOON	Liverpool	5-100		Purington Shale Oak Grove Limestone Jake Creek Sandstone Francis Creek Shale Colchester (No. 2) Coal Browning Sandstone
KEWANEE	SPOON	Abingdon	1-15		Isabel Sandstone
KEWANEE	SPOON	Greenbush	1-14		Greenbush Coal
KEWANEE	SPOON	Wiley	1-5		Wiley Coal
KEWANEE	SPOON	Seahorne	3-12		Seahorne Limestone
KEWANEE	SPOON	DeLong Brush Hermon	9-40		DeLong, Brush, & Hermon Coals
KEWANEE / McCORMICK	SPOON / ABBOTT	Seville	3-38		Seville Limestone Rock Island (No. 1) Coal
McCORMICK	ABBOTT	Pope Creek	1-30		Bernadotte Sandstone Pope Creek Coal
McCORMICK	ABBOTT	Tarter	3-22		Tarter Coal
McCORMICK	ABBOTT	Babylon	3-40		Manley Coal Babylon Sandstone
McCORMICK	ABBOTT		0-4		
PRE-PENNSYLVANIAN					

Fig. 2 - Generalized geologic column of Pennsylvanian strata in west-central Illinois.

average depth of about 50 feet, and locally to as much as 200 feet over buried bedrock valleys. The Nebraskan glacier (about 900,000 years ago) barely entered the western part of the area, and its deposits are rarely exposed. The Kansan glacier (about 700,000 to 600,000 years ago) completely covered the area, and its deposits are widespread beneath younger drift, but also are rarely exposed. Illinoian drift deposited during three separate advances of the Illinoian glacier (about 250,000 to 200,000 years ago) extensively underlies the uplands and is exposed in many places. Wisconsinan loess forms the surficial material throughout the area. The Wisconsinan glaciers (70,000 to 5,000 years ago) reached only as far as southern Tazewell County, 25 miles to the northeast, and did not enter the Havana area. However, great amounts of Wisconsinan outwash were deposited in the Illinois Valley. Westerly winds deposited the loess during Wisconsinan time, and also formed the sand dunes in the Havana Lowland.

Coal is the most important mineral resource being exploited in the area. Sand and gravel are also being produced from glacial outwash.

GLACIAL HISTORY OF ILLINOIS

A knowledge of Illinois glacial history and the glacial deposits is necessary for full appreciation of many points of geologic interest in the Havana area. The following summary is a brief introduction to these subjects and should be read before the field trip begins.

Thousands of years ago much of northern North America was covered by huge glaciers. These glaciers, which advanced from centers in eastern and central Canada, developed when the mean annual temperatures were a few degrees lower than they are now, and the winter snows did not completely melt during the summers. After many years a sheet of ice accumulated that was so thick its weight caused it to flow outward, carrying with it the soil and rocks on which it rested and over which it moved.

The Pleistocene Epoch or "Great Ice Age" began about one million years ago and ended about five thousand years ago. During this epoch, there were four major stages of glaciation, each followed by a long interglacial stage characterized by climatic conditions much as they are today (see fig. 3 on next page).

The oldest glacial stage is the Nebraskan, named after the state of Nebraska where extensive Nebraskan deposits are buried beneath the younger glacial deposits. In Illinois the Nebraskan deposits are also buried, and there are only rare exposures of Nebraskan till in extreme western Illinois. A warm climatic interval, called the Aftonian (interglacial) Stage, followed the melting of the Nebraskan glacier.

The next glacial climate produced the Kansas glacier, which left thick deposits of fine rock materials and outwash sand and gravel in Illinois when it melted away. The Kansan Stage was followed by the Yarmouthian (interglacial) Stage. During this stage, erosion carved valleys and hills, and soils were formed in the Kansas deposits.

The third glacial stage, the Illinoian, is particularly important to the residents of Illinois. The Illinoian glacier, in three separate advances (Liman, Jacksonville, Buffalo Hart), covered 80 percent of the state, reaching southward to Carbondale and Harrisburg. After several thousand years, a warm stage caused

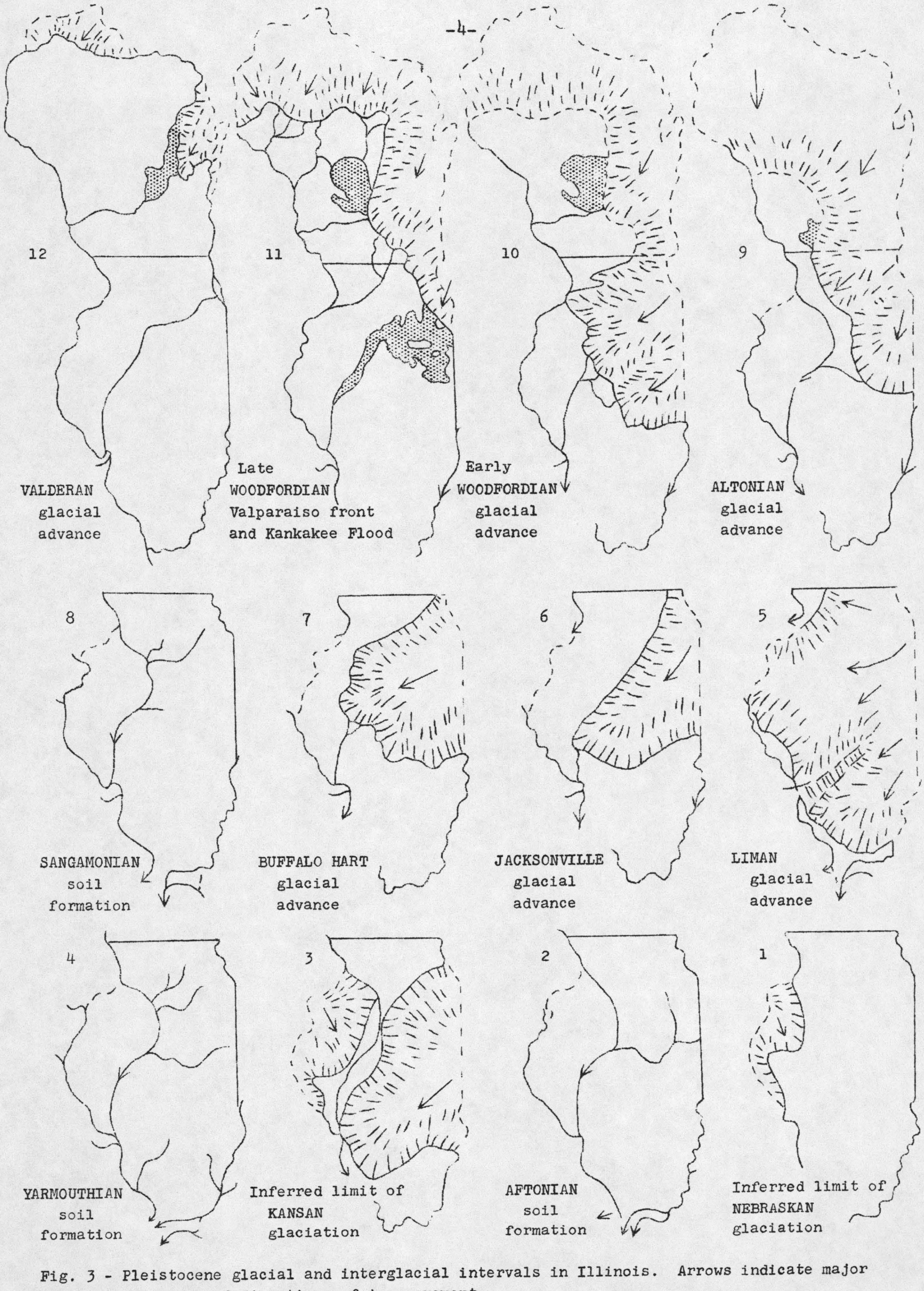


Fig. 3 - Pleistocene glacial and interglacial intervals in Illinois. Arrows indicate major drainage and directions of ice movement.

TIME TABLE OF PLEISTOCENE GLACIATION
(after J. C. Frye and H. B. Willman, 1960)

STAGE	SUBSTAGE	NATURE OF DEPOSITS	SPECIAL FEATURES
RECENT	Years Before Present	Soil, youthful profile of weathering, lake and river deposits, dunes, peat	
	5,000		
WISCONSINAN (4th glacial)	Valderan	Outwash	Outwash along Mississippi Valley
	11,000		
	Twocreekan	Peat and alluvium	Ice withdrawal, erosion
	12,500		
	Woodfordian	Drift, loess, dunes, lake deposits	Glaciation, building of many moraines as far south as Shelbyville, extensive valley trains, outwash plains, and lakes
	22,000		
	Farmdalian	Soil, silt and peat	Ice withdrawal, weathering, and erosion
	28,000		
	Altonian	Drift, loess	Glaciation in northern Illinois, valley trains along major rivers, Winnebago drift
	50,000 to 70,000		
SANGAMONIAN (3rd interglaical)		Soil, mature profile of weathering, alluvium, peat	
ILLINOIAN (3rd glacial)	Buffalo Hart	Drift	Glaciers from northeast at maximum reached Mississippi River and nearly to southern tip of Illinois
	Jacksonville	Drift	
	Liman	Drift, loess	
YARMOUTHIAN (2nd interglacial)		Soil, mature profile of weathering, alluvium, peat	
KANSAN (2nd glacial		Drift Loess	Glaciers from northeast and northwest covered much of state
AFTONIAN (1st interglacial)		Soil, mature profile of weathering, alluvium, peat	
NEBRASKAN (1st glacial)		Drift	Glaciers from northwest invaded western Illinois

the Illinoian ice sheet to melt. During this warm stage, the Sangamonian, the upper part of the deposits left by the glacier was weathered and soil developed, as in the preceding Yarmouthian interval. These ancient Sangamonian soils resemble present-day soils in color, texture, and depth, suggesting that the climate during interglacial times was similar to our present climate.

The last and most recent glacial stage in Illinois was the Wisconsinan, which began about 70,000 years ago. The Wisconsinan comprised three major glacial advances--the Altonian, the Woodfordian, and the Valderan. Little is known about the extent of the Altonian glacier, as its deposits were overridden by later glaciers, except in northern Illinois. The Woodfordian glacier advanced southward from the Lake Michigan basin to the present sites of Shelbyville, Decatur, Charleston, and Peoria. The Valderan glacier reached its maximum extent near Milwaukee, Wisconsin, and did not enter Illinois.

When the glaciers melted, they released the rock materials they had picked up as they advanced. These materials are called <u>glacial drift</u>. Some of the glacial drift was washed out with the meltwaters and is called <u>outwash</u>. The coarsest material (gravel, sand) carried by the meltwater was deposited nearest the front, and the finer material (silt, clay) was carried farther away, with some possibly carried all the way to the sea. Where the outwash was spread widely along the front of the glacier, it formed an <u>outwash plain</u>. Where the outwash was restricted to the stream valleys, it formed <u>valley train deposits</u>. Many valley trains in Illinois are buried beneath younger glacial drift.

Glacial drift deposited directly by the ice is called <u>till</u>. It is unsorted and unstratified and consists of a mixture of all kinds and sizes of rock fragments. As the Wisconsinan glacier wasted away, the ice front melted back and readvanced many times, creating a complex sequence of till deposits in northeastern Illinois, the most outstanding of which are end moraines. More than 50 successive end moraines were formed by the Wisconsinan glacier in Illinois alone. The major ones are shown on the accompanying glacial map of northeastern Illinois.

An <u>end moraine</u> is an accumulation of drift at the ice margin when the rate of advance and the rate of melting of a glacier are essentially in balance. As more and more rock debris is brought to the edge of the glacier, it piles up and formes a ridge.

The surface relief of end moraines is generally greater than that of the surrounding area and is referred to as <u>swell-and-swale</u> or <u>knob-and-kettle</u> topography. At some places there are large gaps in the moraines where subglacial streams presumably carried away most of the drift. The flatter areas behind end moraines are called <u>ground moraines</u> or <u>till plains</u>.

At times, especially in the fall and winter, the meltwaters subsided, exposing the valley trains. The wind picked up silt and fine sand from the floodplains and dropped these materials on the bluffs and uplands to form deposits of loess. Loess mantles most of Illinois. Near the large river valleys it may be as much as 60 to 80 feet thick, but it thins rapidly away from the valleys.

The importance of the Pleistocene Epoch to Illinois is emphasized by the rich soils formed from the glacial deposits and by the abundant deposits of sand and gravel. The glacial outwash, especially buried valley trains, is an important source of ground water. The state would not have these valuable resources if the glaciers had not invaded Illinois.

SEDIMENTARY HISTORY OF THE PENNSYLVANIAN ROCKS

Most of the strata forming the bedrock surface in the field trip area are of Pennsylvanian age, so the origin and character of these rocks is discussed below in considerable detail. Since coal is being extensively mined in this part of the state, the origin of coal is also discussed briefly.

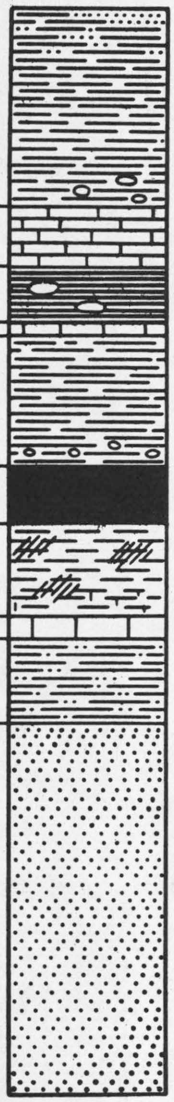
Pennsylvanian sedimentary rocks form the bedrock surface over approximately four-fifths of Illinois and have a maximum cumulative thickness of about 3000 feet. They were deposited between about 270 and 310 million years ago, and contain all of Illinois' minable coal beds, whose recoverable reserves are estimated at 137 billion tons. Coal is one of the state's most important mineral resources, accounting for over one-third of the total production value, which in 1967 amounted to approximately $650,000,000. In 1967, almost 65 million tons of coal valued at over $251 million were mined in Illinois, ranking the state fourth among the coal-producing states in the nation.

Unlike the older sedimentary rocks in Illinois, which consist of fairly thick units of limestone, dolomite, sandstone, and shale, the Pennsylvanian strata are made up of comparatively thin rock units, often only a few inches thick and rarely exceeding 30 feet. They are characterized by frequent and abrupt vertical changes in rock type. Several hundred individual units--sandstone, shale, siltstone, clay, limestone, and coal--are present in the Pennsylvanian System. Many of these individual units are quite variable in thickness and grade laterally from one rock type to another. However, some units, especially the limestones, are very persistent laterally and can be traced over large areas of the state.

The individual rock units occur in regular sequences which are repeated many times. Each regular sequence represents a cycle of sedimentation during which the individual units were deposited under environmental conditions that changed with time. Each cycle of sedimentation, called a cyclothem, consists of several lithologic units, part of which were deposited under marine conditions and part under nonmarine conditions. An ideally complete cyclothem consists of ten distinct sedimentary units, and the chart on the next page shows the arrangement of units in the ideal cyclothem. Usually one or more units are missing, but the order of arrangement with a few exceptions is almost always the same. The units which are most commonly present are a basal sandstone overlain by an underclay, coal, black slaty shale, limestone, and gray shale.

The variety of sedimentary rock types in the Pennsylvanian System, the thinness of individual units, the abrupt and frequent vertical changes in rock types, and the lateral variations in thickness and lithology of most units indicate a wide range of depositional conditions which changed fairly rapidly with time. The cyclical character of the sedimentary sequences also indicates that the depositional conditions during Pennsylvanian time changed in a regular manner. The geologic framework which produced these conditions is not exactly known, but it was unique to the Pennsylvanian Period, because no other system of sedimentary rocks in the geologic column exhibits a comparable development of cyclic sediments.

Geologists have offered several explanations for the Pennsylvanian cyclothems, too numerous and detailed to discuss at the present time. However, the presence of both marine and nonmarine deposits in each cyclothem indicates that invasion and withdrawal of the sea occurred during the formation of each cycle. The repeated alternations of marine and nonmarine sedimentary rocks also indicate that there were many intervals of invasion and withdrawal. In general,



10 Shale, gray, sandy at top; contains marine fossils and ironstone concretions, especially in lower part.

9 Limestone; contains marine fossils.

8 Shale, black, hard, laminated; contains large spheroidal concretions and marine fossils.

7 Limestone; contains marine fossils.

6 Shale, gray; pyritic nodules and ironstone concretions common at base; plant fossils locally common at base; marine fossils rare.

5 Coal; locally contains clay or shale partings.

4 Underclay, mostly medium to light gray except dark gray at top; upper part noncalcareous, lower part calcareous.

3 Limestone, argillaceous; occurs in nodules or discontinuous beds; usually nonfossiliferous.

2 Shale, gray, sandy.

1 Sandstone, fine-grained, micaceous, and siltstone, argillaceous; variable from massive to thin-bedded; usually with an uneven lower surface.

AN IDEALLY COMPLETE CYCLOTHEM

(Reprinted from Fig. 42, Bulletin No. 66, Geology and Mineral Resources of the Marseilles, Ottawa, and Streator Quadrangles, by H. B. Willman and J. Norman Payne)

(28197–20M–6/66)

the sandstone-underclay-coal portion (the lower five units) of each cyclothem is nonmarine and was deposited on coastal lowlands from which the sea had withdrawn. However, some of the sandstones are entirely or partially marine. The units above the coal are marine sediments which were deposited during the invasion part of the cycle. The exact mechanism which caused these repeated relative changes in sea level is not known, but the occurrences of cyclic Pennsylvanian sediments on many of the continents suggests that the sea level fluctuations were world-wide. The following discussion briefly explains the geologic conditions that probably existed in the Illinois-Indiana region during the Pennsylvanian Period.

At the end of the Mississippian Period about 310 million years ago, the Mississippian sea withdrew from the midcontinent region, and a long interval of erosion followed during early Pennsylvanian time. During this erosion interval, several hundred feet of Upper Mississippian strata were eroded away, and an ancient Pennsylvanian river system cut deep channels into the Mississippian sedimentary rocks. This erosion was interrupted by the invasion of the early Pennsylvanian sea.

For the remainder of Pennsylvanian time the northeast part of the Illinois Basin was a broad swampy lowland bordering the shallow sea which lay to the southwest (fig. 4). This lowland stood only a few feet above sea level, so that only slight changes in relative sea level caused great shifts in the position of the shoreline. A slight rise in sea level would have caused submergence of the low borderland, followed by marine deposition; and conversely, a slight lowering would have caused emergence of the lowland and much of the shelf of the Illinois Basin, followed by nonmarine deposition and erosion.

The Pennsylvanian river system, which flowed across the low borderland from the northeast, carried mud and sand from northern highlands and built a great delta out into the sea, much like the present-day Mississippi River delta in Louisiana. Throughout Pennsylvanian time the Illinois Basin continued to subside, and along with the worldwide sea level changes, this caused the position of the shoreline to change continually. The delta front oscillated northward and southward for hundreds of miles due to changes in sea level, intermittent subsidence of the basin, and variations in the amounts of sediment carried seaward from the land.

At various times conditions at any place on the shallow sea floor favored the deposition of sandstone, limestone, or shale. Sandstone was deposited near the mouths of distributary channels. These sands were reworked by waves and spread as thin sheets near the shore. The shales were deposited in quiet water areas--in delta bays between distributaries, in lagoons behind barrier bars, and in deeper water beyond the nearshore zone of sand deposition. Limestone, which formed by chemical precipitation from the sea and the accumulation of limy shells of marine plants and animals, was usually deposited farther from shore than the sandstone and shale, but some limestone was formed in nearshore areas where little sand and mud were being deposited. The areas of sandstone, shale, and limestone deposition continually changed as the position of the shoreline changed and as the delta distributaries extended seaward or shifted their positions laterally along the shore.

The nonmarine sandstones, shales, and limestones were deposited on the deltaic lowland bordering the sea. The nonmarine sandstones were deposited in distributary channels, in river channels, and on the broad floodplains of the rivers. Many of the channel sands are preserved as elongate channel deposits in the cyclothems. Some of these sand bodies, 100 or more feet thick, cut through

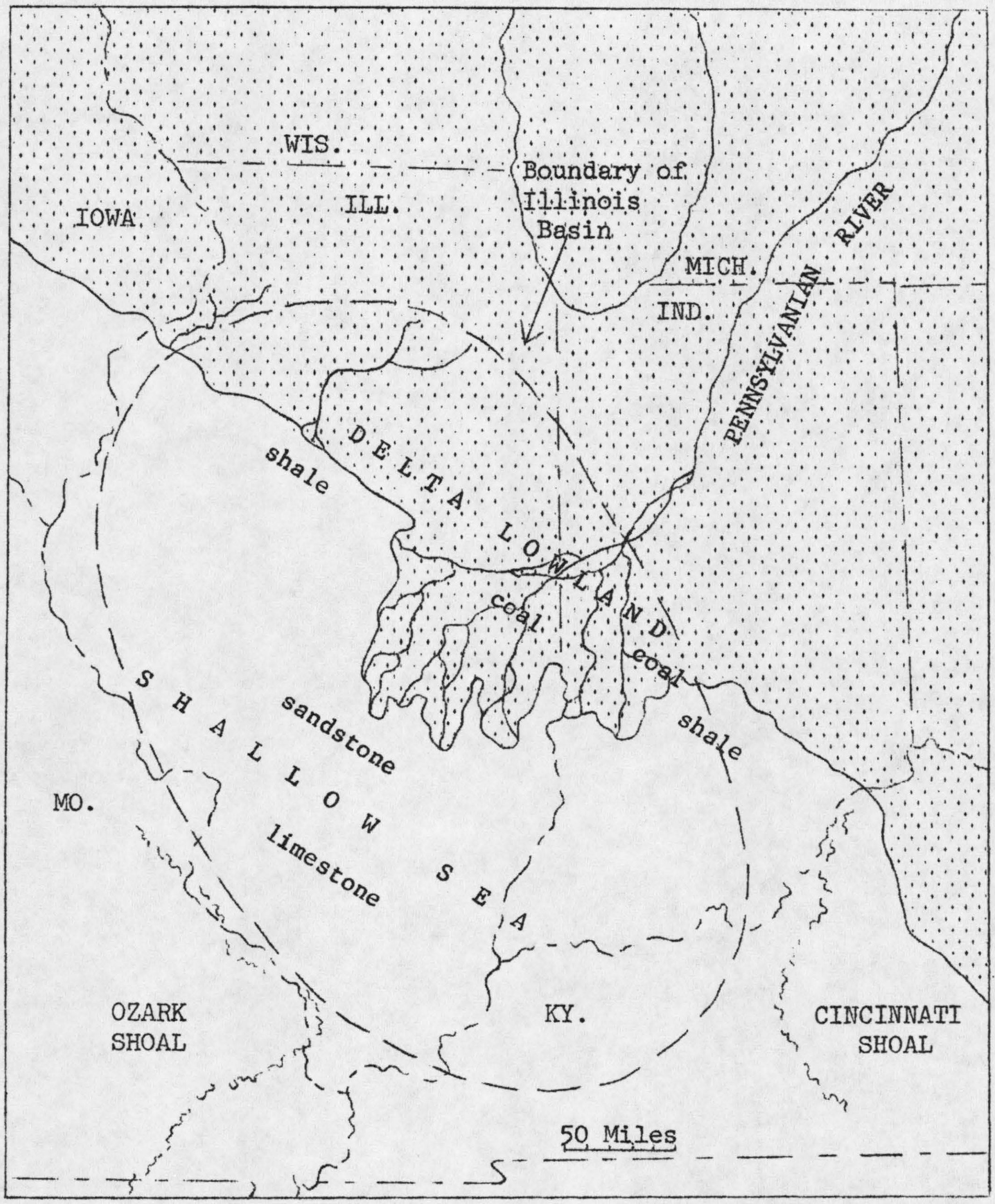


Fig. 4 - Paleogeography of Illinois-Indiana region during Pennsylvanian time. The diagram shows the Pennsylvanian River Delta and the positions of the shoreline and the sea at an instant of time during the Pennsylvanian Period.

many of the underlying rock units. The shales were deposited mainly on floodplains. Fresh-water limestones and some shales were deposited locally in fresh-water lakes and swamps. The coals were formed by the accumulation of plant material, usually where it grew, beneath the quiet waters of extensive swamps. Lush forest vegetation, which thrived in the warm, moist Pennsylvanian climate, covered the region. The origin of the underclays beneath the coals is not exactly known, but they were probably deposited in the swamps as slackwater muds before and during the formation of the coals. The formation of coal marked the end of the nonmarine portion of the depositional cycle. Resubmergence of the borderland by the sea interrupted nonmarine deposition, and the marine portion of the cyclothem was then laid down over the coal.

Origin of Coal

It is generally accepted that the Pennsylvanian coals originated by the accumulation of vegetable matter, usually in place, beneath the waters of extensive, shallow, fresh to brackish swamps. They represent the last-formed deposits of the nonmarine portions of the cyclothems. The swamps occupied vast areas of the deltaic coastal lowland, which bordered the shallow Pennsylvanian sea. A luxuriant growth of forest plants, many quite different from the plants of today, flourished in the warm Pennsylvanian climate. Today's common deciduous trees were not present, and the flowering plants had not yet evolved. Instead the jungle-like forests were dominated by giant ancestors of presently-existing club-mosses, horsetails, ferns, conifers, and cycads. The undergrowth also was well developed, consisting of many ferns, fernlike plants, and small club-mosses. Most of the plant fossils found in the coals and associated sedimentary rocks show no annual growth rings, suggesting rapid growth rates and lack of seasonal climatic variations. Many of the Pennsylvanian plants, such as the seed ferns, became extinct.

Plant debris from the rapidly growing swamp forests, composed of leaves, twigs, branches, and logs, accumulated as thick mats of peat on the floor of the swamps. Normally, vegetable matter rapidly decays by oxidation to water, nitrogen, and carbon dioxide. However, the cover of swamp waters, which were probably stagnant and low in oxygen, prevented the complete oxidation and decay of the peat deposits.

The periodic invasions of the Pennsylvanian sea across the coastal swamps killed the Pennsylvanian forests and initiated marine conditions of deposition. The peat deposits were buried by marine sediments. Following burial, the peat deposits became gradually transformed into coal by slow chemical and physical changes in which pressure (compaction by the enormous weight of overlying sedimentary layers), heat (also due to deep burial), and time were the most important factors. Water and volatile substances (nitrogen, hydrogen, and oxygen) were slowly driven off during the coalification process, and the peat deposits were changed into coal.

Coals have been classified by ranks which depend on the degree of coalification. The commonly recognized ranks of coal, in order of increasing rank, are (1) brown coal or lignite, (2) sub-bituminous, (3) bituminous, (4) semi-bituminous, (5) semi-anthracite, and (6) anthracite. Each higher rank is characterized by increasing amounts of fixed carbon and decreasing amounts of oxygen and other volatiles. Hardness of coal also increases with increasing rank. All of Illinois' coals are bituminous.

Underclays occur beneath most of the coals in Illinois. Because underclays are generally unstratified (unlayered), are leached and possess a bleached appearance, and generally contain plant roots, many geologists consider them to represent the old soils on which the coal-forming plants grew.

The exact origin of the carbonaceous black shales, which occur above many coals, is uncertain. The black shale may represent a deposit which formed under restricted marine (lagoonal) conditions during the initial part of the invasion cycle, when the region was still closed off from the open sea. The lagoons, which formed behind offshore sand bars, were quiet water areas where very fine, iron-rich muds and finely-divided plant debris were washed in from the land. The high organic content of the black shales is also in part due to the carbonaceous remains of plants and animals that lived in the lagoons. The fossil remains of animals in the black shales are typically, although not always, depauperate (dwarf), because they were stunted by toxic conditions in the sulfide-rich waters of the lagoons. Many black shales are virtually barren of fossils because swimming and bottom-dwelling animals could not live in the stagnant waters. The phosphatic siderite nodules, which occur in the Pennsylvanian shales, were formed by chemical precipitation of calcium carbonate, iron carbonate (siderite), and phosphate from the brackish lagoonal waters.

HISTORY OF ILLINOIS VALLEY

At the end of the Tertiary Period of geologic time and before the beginning of the Ice Age 1 million years ago, the central Illinois region was drained by a river system that was much different than the present one (fig. 5). In the field trip area the Illinois Valley was occupied by the Ancient Mississippi River. The Mississippi was joined by the Ancient Mahomet-Teays River near Delavan in southern Tazewell County, flowed through Illinois Valley in western Mason County, and then joined the Middletown River near Kilbourne.

During the Nebraskan glaciation and the following Aftonian interglacial interval, these ancient valleys were greatly deepened by stream erosion as much as 200 feet below the bedrock surface. The Havana Lowland is an unusually broad portion of this ancient valley system, and it marks the junction of the major bedrock valleys and several lesser but fairly large tributary valleys. Lateral erosion by the shifting channels of these rivers gradually cut the lowland into the shaly and relatively soft Pennsylvanian and Mississippian rocks that form its bedrock floor.

During the Kansan glaciation, the bedrock valleys and most of the Havana Lowland were partially filled by glacial drift. Many of the smaller tributary valleys were obliterated, but the larger streams re-excavated their pre-Kansan valleys during the following Yarmouthian interglacial interval. A significant drainage change as a result of the Kansan glaciation was the permanent establishment of the Illinois Valley between Peoria and Pekin and the abandonment of the Mackinaw Valley, which had been blocked by the Kansan ice (fig. 5).

Illinoian glaciation during three separate advances (Liman, Jacksonville, Buffalo Hart) completely buried the bedrock valleys tributary to the Illinois Valley. However, the Illinois Valley was not completely filled, and when the ice had melted away, it continued to serve as the region's major drainageway. At the end of the Illinoian glaciation, meltwater from the Buffalo Hart glacier initiated the present tributary system. During the warm Sangamonian Stage that followed, the Ancient Mississippi River re-excavated the Illinois Valley, and the new tributaries were deepened and permanently established.

The Wisconsinan glacier did not cover the Havana area. At its maximum extent during the Shelbyville advance about 22,000 years ago, the glacier reached only as far as a line from Peoria to Delavan, about 30 miles northeast of Havana (see attached Glacial Map of Northeastern Illinois and fig. 3, # 10). The Shelbyville glacier also blocked the upper Illinois Valley and permanently diverted the

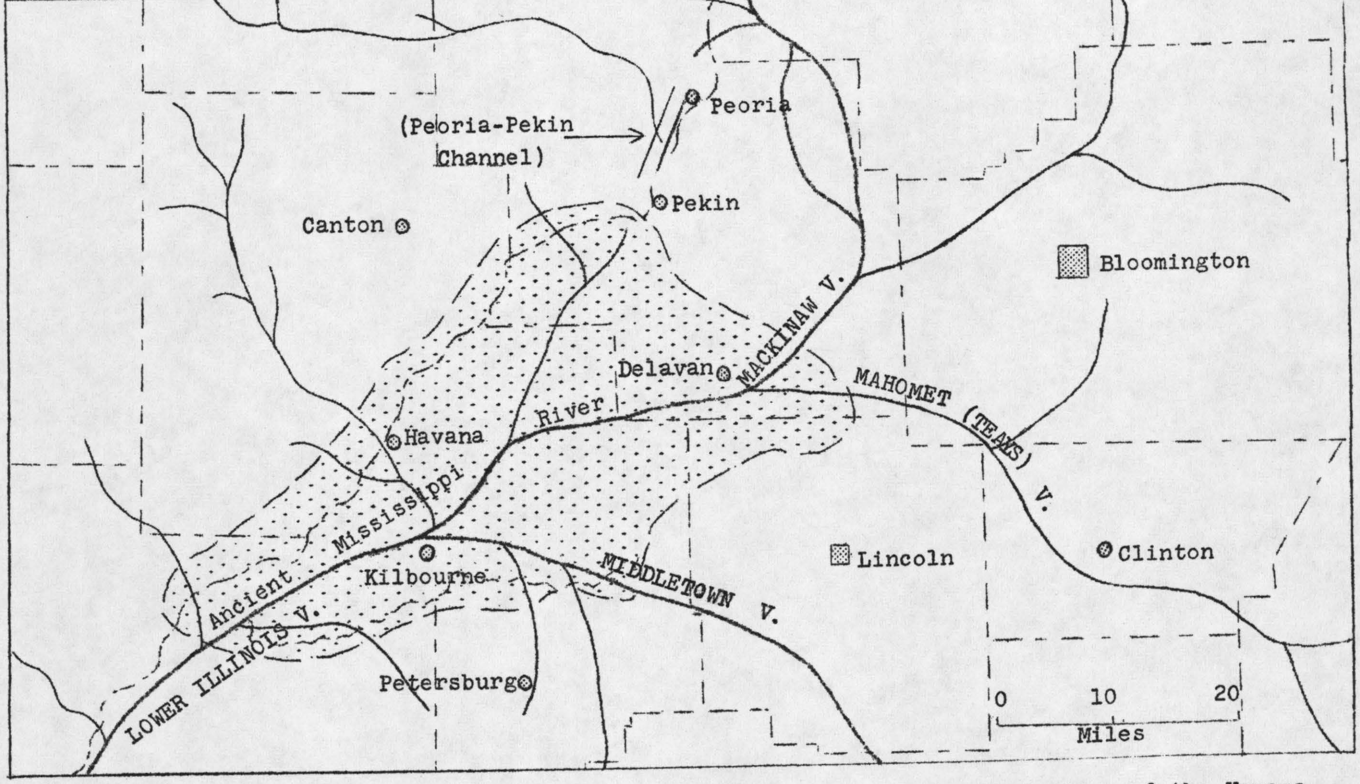


Fig. 5 - Axes of the major bedrock valleys of west-central Illinois and location of the Havana Lowland (stippled area). The position of the Kansan diversion channel of Illinois Valley (Peoria-Pekin Channel) is indicated.

Mississippi River westward into its present valley. Illinois Valley has since been occupied by the Illinois River.

During the Altonian advance (early Wisconsinan) and later throughout Woodfordian time (late Wisconsinan), when the glacier was building the numerous end moraines in northeastern Illinois, the Illinois Valley was a major meltwater outlet. Much outwash was deposited in the valley, and thick loess was deposited on the bluffs and adjoining uplands. Illinois Valley also served as a meltwater channel for the Valderan glacier. Five terrace levels in the Havana area record events that occurred during the Wisconsinan glaciation.

	Terrace Level	Elevation
(Oldest) 1.	Slackwater terrace (Bloomington)	480-550'
2.	Manito terrace (Early Kankakee Torrent)	480-500'
3.	Havana terrace (Late Kankakee Torrent)	465-480'
4.	Bath terrace (Early Lake Chicago)	445-465'
(Youngest) 5.	Beardstown terrace (Late Lake Chicago) (5 to 15' above floodplain)	435-445'

While the Wisconsinan glacier stood at the Bloomington front, about 15,000 years ago, unusually rapid melting of the ice caused the deposition of an enormous outwash fan of sand and gravel in the Havana Lowland, extending from the Bloomington Moraine at Peoria southwestward beyond Beardstown. This valley train raised the level of the Illinois Valley bottom and dammed the mouths of the tributary valleys, causing temporary lakes to form. These slackwater lakes were gradually filled with silt and clay washed in from Illinois Valley and with silt and sand eroded from glacial drift on the uplands. When the Bloomington ice melted back from the Bloomington Moraine, a large meltwater lake (Lake Illinois) was formed between the ice front and the Bloomington Moraine. Overflow from Lake Illinois carried little outwash, and the Illinois River entrenched its channel in the Bloomington outwash fan. The river followed the lowest possible route along the west side of the outwash fan, establishing its present channel along the west side of the Havana Lowland, a course the present Illinois River still follows. The tributary streams also re-excavated their valleys in the slackwater sediments, whose upper surface forms the present slackwater terrace remnants. Throughout the remainder of Woodfordian time for the next 2,000 years, Illinois Valley continued to carry meltwater from the Wisconsinan ice front, and 5 to 15 feet of loess was deposited on the uplands and the slackwater terrace.

Between 13,000 to 12,000 years ago, when the Wisconsinan glacier stood at the position of the Valparaiso Moraine, another great meltwater flood (Kankakee Flood) poured down Illinois Valley (fig. 3, # 11). The torrential currents of the rising waters scoured the surface of the Bloomington outwash fan, eroding it to the level of the Manito terrace and forming numerous elongate sand bars. The estimated height of this enormous flood, based on the elevations of the highest sand bars, is 150 feet above the present level of the Illinois River. After the initial high stage that cut the Manito terrace, the floodwaters waned, and a second lower flood stage eroded the Bloomington outwash to the level of the Havana terrace, about 20 feet below the Manito level. As the flood continued to subside, the river eroded its channel below the Havana level. Strong westerly winds attacked the exposed sand bars, shifting the sands southeastward and forming dunes over the Havana and Manito terraces. Tributary streams adjusted to the level of the waning flood and also cut terraces.

During the Valderan Stage when the Wisconsinan glacier was melting back from the Valparaiso Moraine (about 11,000 years ago), glacial Lake Chicago, an ancestral stage of Lake Michigan, was formed behind the moraine. Overflow from Lake Chicago, which continued for about 2,000 years, drained through the DesPlaines Valley into Illinois Valley. Two stages of overflow from the lake cut the Bath terrace, 15 to 20 feet below the Havana terrace, and the Beardstown terrace, about 20 feet lower. The Beardstown terrace is only 5 to 10 feet above the present floodplain. Lake Chicago abandoned its southern outlet after the Valderan glacier melted from the Straits of Mackinac, and Illinois Valley never again carried glacial meltwater. The post-glacial Illinois River has been a sluggish stream with a gradient of only about 3 inches per mile in the Havana area. At the present time the river and its tributaries are aggrading their valleys. The smaller tributaries have built alluvial fans where they emerge onto the floor of Illinois Valley.

ITINERARY

0.0 0.0 Havana High School. Corner of McKinley and Dearborne (Route 97). Turn left and head east on Route 97.

0.2 0.2 Crossing along the Havana terrace. To the left the foot of the bluff marks the outer edge of the Manito terrace.

0.5 0.7 Railroad crossing.

0.1 0.8 Now crossing the Manito terrace. The terraces in this area are very poorly defined topographically.

0.2 1.0 Unguarded railroad crossing. CAUTION.

0.2 1.2 Note the area of blowing sand in the dune on the left, behind the lumber mill.

0.4 1.6 Crossroads. Turn right on gravel road.

Note the low, slightly rounded dune hills on the Manito terrace in this vicinity.

0.5 2.1 Ascending dune.

0.1 2.2 Stop 1. Crest of sand dune (SE 1/4 SE 1/4 SW 1/4, Sec. 7, T. 21 N., R. 8 W.). Discussion of sand dunes in Illinois Valley.

This stop is on the crest of one of the numerous dune ridges in this portion of the Illinois Valley. Climb to the top of the dune bluff on the right side of the road for a better view of the hummocky topography produced by these dunes. Toward the northeast, behind the lumber mill passed earlier, a dune has been reactivated by man, and the sand is blowing.

This stop is near the western edge of an extensive tract of sand ridges and dunes that cover the broad terraces east of the Illinois River. The tract extends for more than 40 miles in the western portion of the Havana Lowland from the vicinity of Chandlerville in the south northward almost to Pekin. Many of the sand dunes stand 20 to 40 feet high above the level of the valley bottom, and a few are even higher. Most of the sand ridges are actually alluvial sand bars mantled by dune sand. The sand bars were formed by swift-flowing floodwaters of the Kankakee Flood that inundated the Havana Lowland during the melting of the Wisconsinan glacier between about 13,000 and 12,000 years ago. The dune sand was blown by winds that reworked the Wisconsinan outwash of the valley bottom after the floodwaters receded. The dunes are presently stabilized by grass or forest growth, except in areas where they have been reactivated by cultivation.

The sand ridges in the Havana area record one event in the complicated history of the Illinois Valley. This history was briefly reviewed on pages 10 to 12.

0.0 2.2 Leave Stop 1. Continue ahead.

0.2 2.4 Unguarded railroad crossing. CAUTION.

0.2 2.6 Crossroads. STOP. Turn right (north) on blacktop.

The dunes in this area are on the Havana terrace.

0.7 3.3 Unguarded railroad crossing. Two tracks. CAUTION.

Park on right shoulder immediately after crossing tracks.

Stop 2. Dune sand exposed in railroad cut on right (NW 1/4 SW 1/4 NW 1/4, Sec. 7, T. 21 N., R. 8 W.).

This stop affords an opportunity to examine the sand that forms the numerous sand dunes in this area. The sand is fine- to medium-grained and consists predominantly of quartz, but it contains 15 to 20 percent feldspar and minor amounts of darker mineral grains. The sand contains well-rounded, sub-rounded, and angular grains, indicating that many of the grains were not subjected to wind abrasion for very long. Many of the well-rounded grains are probably second cycle sands that were eroded from bedrock by the glaciers. In fresh exposures below the surface soil, the sand is light tan in color, and it exhibits typical eolian crossbedding. The sand here has been weathered and is stained reddish to yellowish brown by iron oxide. The sand contains some silt and clay, and when wet, it is slightly sticky.

0.0	3.3	Leave Stop 2. Continue ahead.
0.3	3.6	SLOW. Entering Havana. Continue ahead on Promenade Street.
0.3	3.9	STOP. Intersection of Promenade and Dearborne Streets. Turn left (west) on Dearborne (Route 97).
0.5	4.4	Four-way STOP. Continue straight ahead toward the bridge.
		Enter Illinois River Bridge.
0.8	5.2	Note the wide expanse of the Illinois Valley floodplain, especially to the left. The floodplain averages 3 to 4 miles wide in the Havana area. In this immediate area the floodplain is only about 30 feet above the bedrock floor of the valley. East of Havana, the bedrock surface is as much as 200 feet below the level of the Manito terrace.
0.2	5.4	Junction, Routes 97 - 136. Continue ahead (west) on Route 136.
3.1	8.5	Junction with Route 100 from the left. Turn left (south) on Route 100.
1.1	9.6	The relatively even upland here is an undissected remnant of the Buffalo Hart till plain.
0.4	10.0	Descending into Otter Creek valley. Note the view of Illinois Valley to the left.
0.4	10.4	Crossing the Havana terrace.
0.9	11.3	Enter village of Enion.
0.2	11.5	Cross Otter Creek.
0.5	12.0	SLOW. Prepare to turn right.
0.1	12.1	T-road from right. Turn right (west) on blacktop.
1.9	14.0	Crossroads (Hickory School). Continue ahead (west) on blacktop.
1.7	15.7	SLOW. Prepare to turn left at curve ahead.

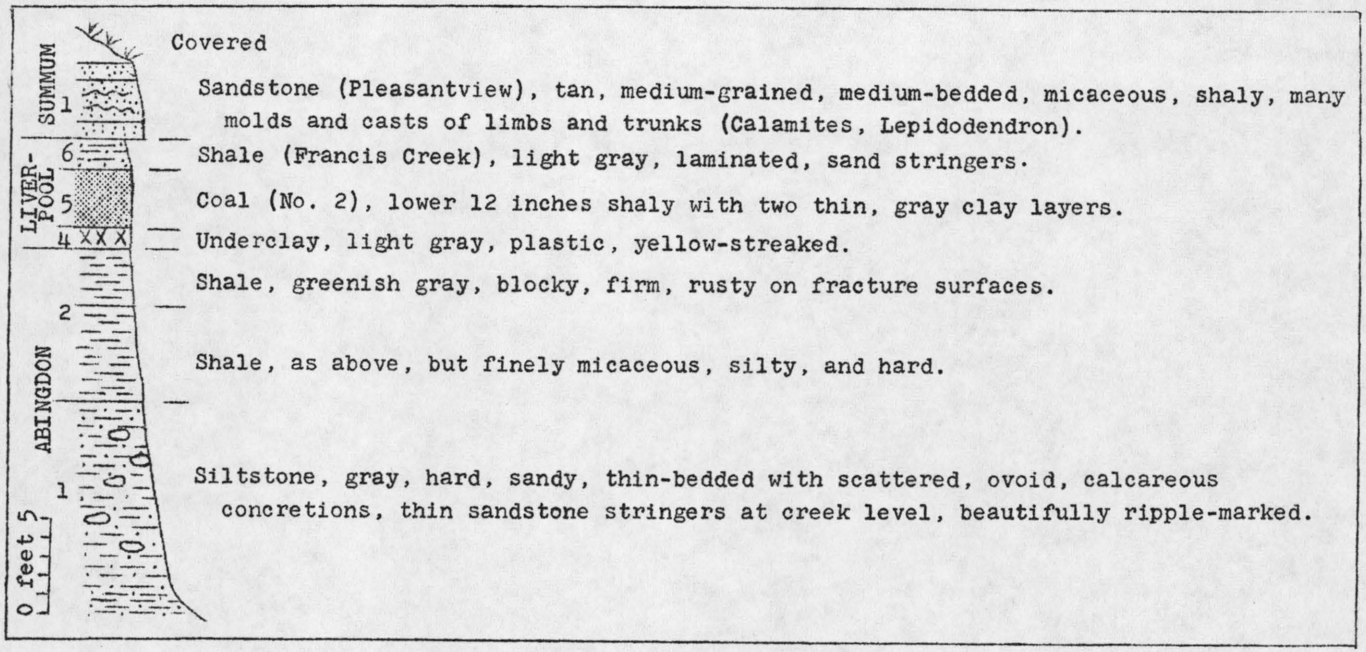


Fig. 6 - Strata exposed at Stop 3. Numbers indicate units of the ideal cyclothem.

0.1 15.8 Bear left onto gravel road.

0.8 16.6 T-road from right. Turn right.

0.5 17.1 T-road from left. Continue straight ahead.

0.2 17.3 Descend steep hill. CAUTION. At bottom of hill, turn hard right.

0.2 17.5 Stop 3. Exposure of Liverpool Cyclothem and Colchester (No. 2) Coal on the left in cut bank of Kerton Creek (SW 1/4 NW 1/4 SE 1/4, Sec. 14, T. 3 N., R. 2 E.).

This is the first of four stops that will be made to examine the Pennsylvanian sedimentary rocks. Of necessity, mainly because most good exposures are poorly accessible, only a portion of the Pennsylvanian stratigraphic column will be seen during the field trip. However, the cyclic character of the strata and the thinness and lateral variability of individual stratigraphic units will be observed.

This exposure reveals the Colchester (No. 2) Coal and portions of the Abingdon, Liverpool, and Summum Cyclothems (figs. 2 and 6). As is typical, all members of the ideal cyclothem are not present. The Browning Sandstone, the basal channel sandstone of the Liverpool Cyclothem, is absent here. The Francis Creek Shale, which varies from 0 to 45 feet in the Havana area, is only 1.5 feet thick because of truncation by the overlying Pleasantview Sandstone, the basal channel sandstone of the Summum Cyclothem.

The Pleasantview Sandstone has a maximum thickness of 80 feet in its channel phase. At this locality the sandstone has completely cut out the Oak Grove Beds and the Purington Shale, the marine limestone and shale units that form the upper part of the Liverpool Cyclothem over large areas of the Midwest. In many places the sandstone rests directly on the No. 2 Coal, but nowhere does the sandstone cut through the coal. The base of the sandstone represents a major unconformity (erosion surface). After the Liverpool cycle of deposition, the area remained above sea level for a time, and a major interval of valley cutting by the Michigan River took place during which channels were cut in the Liverpool sediments. Of particular interest in this exposure are the numerous impressions of plant limbs and branches (driftwood) in the lower beds of the sandstone, indicating nonmarine conditions during its deposition.

The Colchester (No. 2) Coal is the most widespread coal in the Illinois Basin. Because of this, it is an important stratigraphic marker, and it was made the basal unit of the Carbondale Formation. The coal averages 2'6" thick in Illinois, and its thickness is so uniform that it has been called the "30-inch coal." It is of great economic importance.

The Abingdon Cyclothem belongs to the Spoon Formation. Here it consists of sandy shale and siltstone with calcareous concretions in the lower part. The lower sandy siltstone exposed here probably represents the interdistributary equivalent of the Isabel Sandstone, the basal sandstone of the Abingdon Cyclothem. At the water level, the siltstone contains thin stringers of sandstone. The upper surfaces of the sandstone beds are beautifully marked with symmetrical oscillation ripples, indicating deposition in very shallow water.

0.0 17.5 Leave Stop 3. Continue ahead (northwest) on dirt road.

0.2 17.7 Pleasantview Sandstone exposed on the right. Old mine entries extend under the sandstone into the No. 2 Coal.

0.1 17.8 SLOW. The road in this area is very poor.

0.6 18.4 Several old mine entries on the right in the No. 4 Coal. The Pleasantview Sandstone is exposed at several places along the south bank of Kerton Creek in this vicinity.

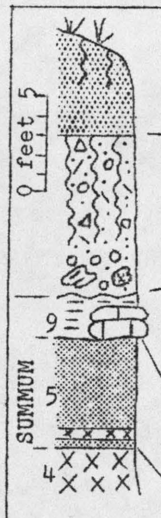
0.4 18.8 T-road intersection. Continue across intersection and park.

Stop 4. Exposure of Summum (No. 4) Coal and Pleistocene deposits in roadcut (SW 1/4 NE 1/4 NE 1/4, Sec. 15, T. 3 N., R. 2 E.).

The Pennsylvanian strata exposed here belong to the Summum Cyclothem of the Carbondale Formation (fig. 7). This exposure reveals strata above the Pleasantview Sandstone, the basal nonmarine sandstone of the cyclothem. The Summum Cyclothem ranges from 11 to 85 feet thick and is thickest in areas of good channel development of the Pleasantview Sandstone.

Like the No. 2 Coal, the Summum (No. 4) Coal is also a widespread and economically valuable coal. It is commonly only about 4 inches thick, but it is 3 to 5 feet thick in areas where the Pleasantview channel sandstone is best developed. Apparently the thickest coal accumulated in valleys that were only partially filled by the Pleasantview sand.

The Hanover Limestone is the marine limestone member of the Summum Cyclothem, although here it is poorly developed and consists of unfossiliferous, conglomeratic, argillaceous, septarian nodules. The peculiar turtle-like appearance (septarian structure) of the nodules represents a network of shrinkage cracks that formed during solidification of the nodules. The cracks developed because of the high clay content of the limestone. They were later recemented by calcium carbonate derived from the surrounding shale. The Hanover Limestone is very discontinuous in the Havana area, suggesting that the Pennsylvanian sea was too muddy



PLEISTOCENE

WISCONSINAN

Peoria Loess, rusty to reddish tan, leached.

ILLINOIAN

Buffalo Hart, till, yellow-brown, silty, pebbly, leached, with iron and manganese stained Sangamon Soil in upper part, lower 1.5 feet with pieces of Pennsylvanian sandstone, shale, and coal.

PENNSYLVANIAN

Shale, blue-gray, carbonaceous plant fragments, contains large, discoidal, septarian limestone nodules (Hanover) in two layers, up to 12 inches thick and 2.5 feet in diameter, dark gray, fine-grained, brecciated, with light brown calcite veins, nonfossiliferous.

Coal (No. 4), split by 5 1/2-inch dark to light gray underclay in lower part.

Underclay, dark gray, with 7-inch light gray interval.
(base covered)

Fig. 7 - Strata exposed at Stop 4.

here to permit continuous limestone deposition. The limestone becomes thicker and purer toward the southwest, indicating that the open sea was in that direction. The Hanover Limestone is one of the most widespread Pennsylvanian limestones in the central United States.

Illinoian Buffalo Hart till and Wisconsinan loess are exposed above the Pennsylvanian strata in this exposure. At its maximum extent the Buffalo Hart glacier completely covered the Havana area (fig. 3, # 7). Till is an ice-laid deposit characterized by its lack of sorting and lack of stratification. Note the wide range of particle sizes, including clay, sand, pebbles, and boulders, that make up the till. The rock fragments also consist of many kinds of sedimentary, igneous, and metamorphic types. The igneous and metamorphic rocks were carried into Illinois from the Canadian shield where these rocks are extensively exposed. Note also that the till also includes pieces of Pennsylvanian rocks that were eroded from the bedrock locally, especially in the lower part. The till is overlain by Wisconsinan loess, whose origin will be discussed at the next stop.

Of special interest here is the soil zone developed in the Buffalo Hart till. This ancient soil, now buried beneath the Wisconsinan loess, is the Sangamon Soil. The Sangamon Soil is a weathering profile that was formed during the long, warm interglacial interval, called the Sangamonian Stage, which followed the melting of the Buffalo Hart glacier and lasted from about 200,000 to 70,000 years ago. The Sangamon Soil occurs widely throughout the glaciated areas of the Midwest, and it is used by geologists as a key horizon to indicate the contact between the deposits of the Illinoian and Wisconsinan glaciations. In places where the Sangamon profile is well drained, it has a distinctive reddish color, as will be seen at later stops.

0.0 18.8 Leave Stop 4. Continue to right (north) uphill.

1.4 20.2 T-road from right. Turn right (north).

0.9 21.1 STOP. Intersection with Route 24. Continue ahead on Route 24.

0.3 21.4 Enter village of Summum. Continue ahead on Route 24.

4.5 25.9 Descend into valley of Otter Creek.

0.2 26.1 Cross bridge.

Note the slackwater terrace along the east side of the valley. The green-roofed house on the far left is on this terrace level. The promontory on the right is also the slackwater terrace level. On the far right, the small, isolated, tree-covered hill in the valley bottom is a remnant of the Havana terrace level.

0.9 27.0 Y-intersection, Bear left on Route 24. Prepare to turn hard left immediately. Turn hard left on first gravel road to the west.

0.5 27.5 Y-intersection. Bear left.

0.5 28.0 Otto Cemetery on right. SLOW. Descend steep hill.

0.1 28.1 Turn right at bottom of the hill. Do not cross bridge.

0.2 28.3 Turn right and enter gravel pit.

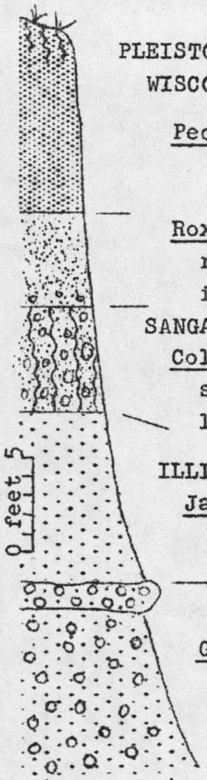
Stop 5. Pleistocene exposure in gravel pit (NW 1/4 SW 1/4 NE 1/4, Sec. 30, T. 4 N., R. 3 E.).

This gravel pit affords an excellent exposure of outwash that was deposited by the Illinoian Jacksonville glacier. Sangamonian slopewash or colluvium overlies the gravel, and this is overlain by Wisconsinan loess (fig. 8). The Sangamon Soil, seen earlier, is also developed in the colluvium and outwash. Here the profile is well drained, and the soil zone is distinctively reddish. This stop affords an excellent opportunity to collect a variety of rock types. Note that many rock fragments are faceted and scratched from abrasion that took place during transport by the ice.

The Illinoian glacier advanced southwestward into the Havana area, moving predominantly parallel to the Illinois Valley. The valley strongly influenced the shape of the ice front, especially that of the Jacksonville advance (fig. 3, # 6). The Jacksonville glacier advanced as a fairly narrow, tongue-shaped lobe 15 miles past Beardstown and as far as Jacksonville in Morgan County, after which it was named. In the Havana area the Jacksonville ice was essentially confined to Illinois Valley, but it mounted the upland and moved westward for 6 to 12 miles, forming a slight projection west of Lewistown (see Itinerary Map).

Much outwash was deposited along the margin of the Jacksonville ice by meltwater flowing between the glacier and the northwest side of Illinois Valley. Lakes were also formed by waters ponded along the ice margin and in the lower parts of valleys that were blocked by the ice. While the glacier occupied the upland, these lakes could drain only by spilling over from one lake to the next along the margin of the ice. The lakes drained across narrow upland divides and cut a series of spillway channels, which became partially filled with outwash. The outwash exposed here at Stop 5 is near the end of one of these old spillway channels (see Itinerary Map), part of which drained across the divide between Tater and Otter Creeks. North Branch Creek and its northern tributary have cut their valleys in the easily eroded outwash along this spillway channel.

Laminated silts and sands, such as those seen here above the coarse gravel, were also deposited in these lakes. The evenly bedded sands in this exposure are typical of outwash sands that were deposited in fairly quiet water.



PLEISTOCENE

WISCONSINAN

Peoria Loess, light grayish brown, weakly calcareous at base.

Roxana Silt, tough, pinkish brown in upper part, becomes darker brown and distinctly reddish in lower part, scattered, small quartz and chert pebbles at bottom, grades into colluvium below.

SANGAMONIAN

Colluvium, tough, till-like, reddish brown, mixed with loess in upper part, silty, sandy, numerous quartz, chert, and igneous pebbles, scattered igneous cobbles, leached with Sangamon Soil.

ILLINOIAN

Jacksonville, sand, coarse, gravelly, silty, massive at top, becomes evenly bedded downward with firm, red beds alternating with friable, brown beds.

Gravel, coarse, silty, with cobbles and boulders, upper 1 to 15 feet cemented by calcium carbonate and forms ledge, gravel contains Pennsylvanian rock fragments, including coal.

Fig. 8 - Strata exposed at Stop 5. The stratified sand above the gravel is exposed at west end of pit.

Note the coarseness of the gravel below the sand. This gravel was deposited while the ice front stood very close to this locality (see Itinerary Map) and indicates the great swiftness of the currents. The sands were deposited in quieter water after the ice front had melted back. The upper part of the gravel is a conglomerate cemented by calcium carbonate that was leached from the overlying deposits during the formation of the Sangamon Soil.

The tough colluvium above the Jacksonville outwash resembles till, but close examination reveals that it is not. Most of the pebbles in this material are quartz and chert, substances that are resistant to weathering. The colluvium represents an accumulation of rock debris that was eroded from Illinoian drift (Jacksonville and Buffalo Hart till) on the north side of Otter Creek during the latter part of the Sangamonian Stage. At that time the climate had become humid, signaling the beginning of the Wisconsinan glaciation, and erosion along the valleys was accelerated. The colluvium moved downslope by gravity and slopewash and accumulated at the base of the valley slope. Much of the colluvium consists of debris that was eroded from the Sangamon Soil profile. Weathering continued during its deposition. Loess deposition began before colluvial deposition ended, and the upper part of the deposit is mixed with loess.

The Roxana Silt above the colluvium is a loess deposit that formed during the advance and retreat of the early Wisconsinan Altonian glacier between about 70,000 and 28,000 years ago. The Roxana has a distinctly pinkish cast that distinguishes it from the light brown Peoria Loess above. In the Havana area the Roxana Silt is 2 to 9 feet thick.

The Peoria Loess was deposited during the advance and retreat of the Woodfordian glacier during late Wisconsinan time between about 22,000 and 12,000 years ago. In the Havana area the Peoria Loess reaches a thickness of 50 feet in the bluffs along Illinois Valley.

The Wisconsinan loess deposits consist mainly of silt that was blown from the valley trains of the major valleys that drained the Wisconsinan glacier. Prevailing westerly winds blew silt and clay from the surfaces of the valley trains, which were largely unvegetated outwash flats, and deposited these materials on the adjacent bluffs and uplands. The loess is thickest in the bluffs of the valleys, especially on the east sides, and it thins rapidly eastward away from the source valleys until it is only a few inches thick in extreme eastern Illinois. Most of the loess was probably deposited during the fall and early winter when, because of colder conditions, the glacial meltwaters had receded, exposing the surfaces of the valley trains. The sediments dried out and were more easily eroded by the wind. The Mississippi and Illinois Valleys were the principal sources of loess for the Havana area.

0.0 28.3 Leave Stop 5. Return to Route 24.

0.2 28.5 Turn left and head uphill.

0.6 29.1 Y-intersection. Bear right.

0.4 29.5 STOP. Intersection with Route 24. Cross highway and continue straight ahead through intersection on gravel road.

0.1 29.6 STOP. Intersection with Route 136. Continue ahead (east) on Route 136.

2.2 31.8 SLOW. Prepare to turn left.

0.1 31.9 T-road from left. Turn left (north) on gravel road.

0.2 32.1 <u>Stop 6</u>. Exposure of Illinoian (Mendon?) till in bluff on left side of road (NE 1/4 SW 1/4 SE 1/4, Sec. 22, T. 4 N., R. 3 E.).

About 25 feet of Illinoian till is exposed here, and the characteristic properties of till can be examined (see page 17). The till is strongly calcareous from top to bottom with only a thin surface soil at the top. The till is probably the Mendon till that was deposited by the first advance of the Illinoian glacier (Liman advance) into the Havana area. The Mendon till is typically gray in color. The upper 7 feet of the till is oxidized to grayish brown and contains thin sand stringers. The lower, unweathered till is gray, massive, and calcareous. Erosion along Illinois Valley has stripped away the younger Illinoian drift and the Wisconsinan loess deposits at this locality. Unweathered till is calcareous because the glaciers passed over extensive areas of limestone, dolomite, and calcareous shale as they advanced into the Midwest.

0.0 32.1 Leave Stop 6. Continue ahead.

On the right is the Bath terrace. The road in this vicinity is following the top of the Havana terrace. The Havana terrace slopes gently down to the Bath level, which gradually merges eastward with the floodplain of the Illinois River.

1.3 33.4 Ascending to the Bloomington slackwater terrace above the Havana terrace.

0.2 33.6 Narrow bridge. Pleasantview Sandstone on the left.

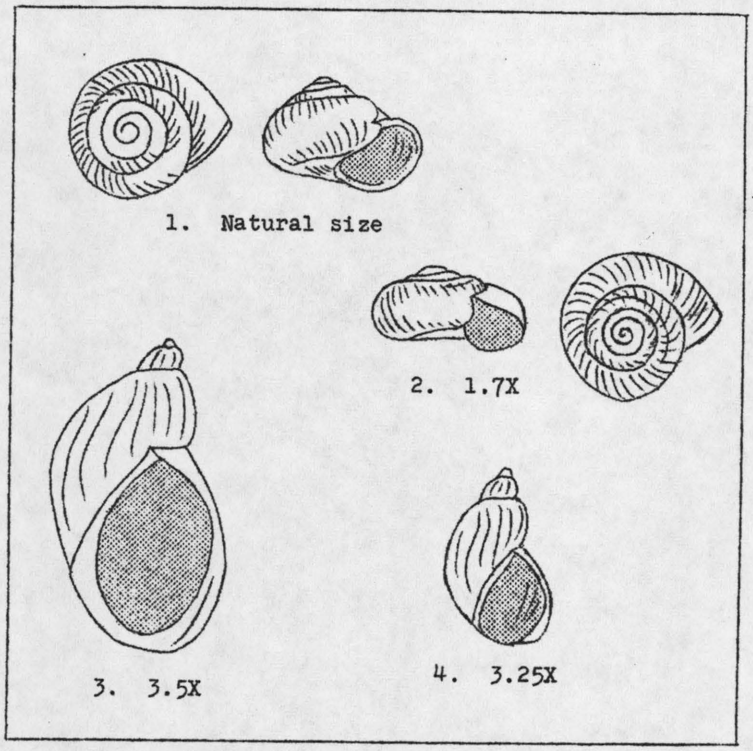


Fig. 9 - Fossil snails in the Peoria Loess at Stop 7. Approximate enlargements are indicated. 1. Mesodon clausus; 2. Haplotrema concavum; 3. Succinea grosvenori; 4. Succinea gelida.

0.8 34.4 Spoon River on the right.

1.1 35.5 STOP. Intersection with Route 100. Turn right (north) and cross bridge over Spoon River.

0.4 35.9 On the right, the sloping terrace level on the point is the Bloomington slackwater terrace.

1.5 37.4 SLOW. Prepare to turn right.

0.1 37.5 T-road from right. Turn right (east) on gravel road.

1.0 38.5 Intersection. Continue ahead (southeast).

2.4 40.9 Stop 7. Exposure of loess in roadcut (SE 1/4 SW 1/4 NE 1/4, Sec. 11, T. 4 N., R. 3 E.).

The Roxana Silt (about 6.5 feet) and the Peoria Loess (about 18 feet) are beautifully exposed in this roadcut. The contact between the pinkish Roxana and the overlying tan Peoria is clearly exhibited at the south end of the cut. The Roxana is leached, but the lower 12 feet of the Peoria Loess below the surface soil is calcareous. After deposition of the Roxana Silt, there was a 6,000-year interval of weathering before deposition of the Peoria Loess began. This weathering interval is called the Farmdalian, and it marks a brief but major withdrawal of the Wisconsinan glacier from Illinois. During this time the carbonates were leached from the Roxana Silt.

The characteristic property of loess to stand in vertical faces is also well exhibited. Loess has excellent vertical drainage, and when cut in vertical faces, it forms stable slopes. When cut at an angle, loess slopes are unstable and are subject to excessive gullying and slumping.

Of special interest here are the fossil snails in the Peoria Loess (fig. 9). These occur mainly in a 4-foot zone, 6 feet above the base. These snails are terrestrial species that lived on the bluffs while the loess was being deposited. The best way to collect them is to take a sackful of loess home for washing. When wet, the snails are quite fragile, but when dry, they can be handled.

0.0 40.9 Leave Stop 7. Continue ahead. Turn left on T-road from left.

On the right is the level of another remnant of the Havana terrace. The terrace slopes gradually down to the level of the floodplain.

0.5 41.4 Waterford Union Church on left.

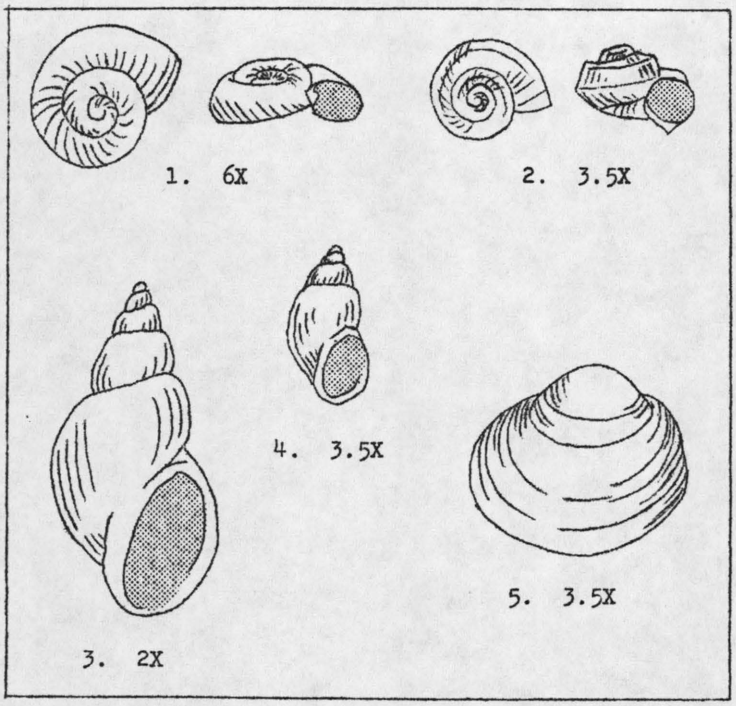


Fig. 10 - Some of the more abundant fossil molluscs in the slackwater deposits. Approximate enlargements are indicated. 1. Gyraulus altissimus; 2. Valvata tricarinata; 3. Lymnaea palustris; 4. Lymnaea parva; 5. Pisidium caseratanum.

0.1 41.5 STOP. T-road intersection. Turn right (east) around curve.

0.2 41.7 Cross East Creek.

0.3 42.0 STOP. T-road intersection with blacktop. Turn left and head uphill toward Dickson Mounds.

0.2 42.2 Turn left and enter Dickson Mounds park area.

Stop 8. Lunch. Resume mileage after lunch.

During the lunch period, participants may visit the village sites and museum facilities that are presently open. Under State ownership, the mound site is presently under the direction of the Illinois State Museum at Springfield, Construction of the new museum building began on July 8, 1968.

The Dickson Mounds gravesites were excavated by Dr. Don Dickson, his father, Thomas Dickson, and his uncles, Ernest L. and Marion H. Dickson. The work began in 1927 and continued for several years. The area enclosed by the museum building had been farmed for many years before the graves were discovered. The material used by the Indians to build the mound was Peoria Loess. More detailed discussions of the mound builders and their culture can be obtained from the museum brochure.

0.0 42.2 Leave park entrance. STOP at intersection with blacktop. Turn right (south).

0.2 42.4 T-road from right. Turn right (west) on gravel road.

0.3 42.7 Cross East Creek.

0.2 42.9 T-road from left. Continue ahead on main gravel road.

0.4 43.3 Cross East Creek and STOP.

Stop 9. Exposure of Bloomington slackwater deposits in south bank of East Creek (SW 1/4 SW 1/4 SE 1/4, Sec. 2, T. 4 N., R. 3 E.).

This exposure affords an opportunity to examine the nature of the Bloomington slackwater terrace deposits. The origin of these sediments was discussed on page 12. The section exposed here is as follows:

<u>Peoria Loess</u>, upper 25 feet leached and brown, lower part calcareous and greenish gray, contains fossil snails . . . . 8.0'

<u>Bloomington slackwater deposits</u>

Gravel, calcareous . . . . 1.0'

Sand and silt, consisting of laminations of bluish gray sand and brick red silt; some bands of gravel; abundant fresh-water snails and pelecypods . . . . 9.5'

Clay and silt, brick red to maroon, calcareous, sparse fossils . . . . 4.0'

Clay and silt, alternating dark gray and maroon layers; base concealed . . . . 5.5'
(water level)

Note the characteristic pinkish and reddish color of the Bloomington deposits. The Bloomington till in northern Illinois is commonly pink or red, and red outwash from the Bloomington glacier was the source of the red color in the slackwater sediments. Reddish sediment washed in from Illinois Valley forms the bulk of the slackwater deposits in the lower parts of the tributary valleys, but the red color becomes more restricted to the lower part of the sediments farther upstream. The slackwater deposits upstream were derived mostly from the valleys themselves and are brown and gray.

Abundant aqueous snails and pelecypods lived in the slackwater lakes (fig. 10). These fossils are very small, especially the pelecypods, and they are best collected by taking samples of the sediment for washing at home.

0.0 43.3 Leave Stop 9. Continue ahead.

1.2 44.5 T-road from left. Continue ahead around curve.

1.6 46.1 T-road from right. Bear left around curve and cross East Creek.

Enter Lewistown. SLOW.

0.6 46.7 STOP. T-road intersection with South Main Street (Route 100). Turn left (north).

0.4 47.1 Cross railroad.

Turn left on West Avenue "F."

0.1 47.2 Turn left on South Madison Street.

0.3 47.5 Turn right on West Avenue "H." Continue ahead on blacktop.

0.7 48.2 Cross creek.

0.3 48.5 <u>Stop 10</u>. Francis Creek Shale with plant fossils in roadcut (NW 1/4 SE 1/4 NW 1/4, Sec. 28, T. 5 N., R. 3 E.).

In the roadcut on the right, the same strata that were seen at Stop 3 are exposed. The Pleasantview Sandstone, Francis Creek Shale, Colchester (No. 2) Coal, and the underclay are exposed. The Pleasantview Sandstone occupies shallow channels in the Francis Creek Shale and shows lenticular cross-bedding. Cross-bedding is characteristic of alluvial sandstones. The cross-bedding was formed by variable currents during deposition of the sandstone.

Of particular interest here are abundant, well-preserved carbonaceous films of delicate fern leaves in the Francis Creek Shale. The fern leaves are especially abundant in an interval about 2 to 4 feet below the sandstone. They occur as fragile films on the bedding planes of the shale and are difficult to collect. For preservation, they should be dried and sprayed with shellac or plastic as soon as possible.

0.0 48.5 Leave Stop 10. Continue ahead.

0.7 49.2 T-road intersection. Turn right (north).

0.4 49.6 Note how flat the Buffalo Hart till plain is in this area.

0.2 49.8 STOP. Crossroads with blacktop road. Turn right (east) on blacktop.

1.4 51.2 T-road from left. Continue ahead uphill. SLOW. Rough road.

Enter Lewistown. West Avenue "E."

0.5 51.7 STOP. Intersection with South Main Street. Turn left (north) on Route 100.

1.0 52.7 Railroad crossing. Continue ahead (north).

0.5 53.2 Y-intersection. Bear right on Route 100.

SLOW. Prepare to turn left.

2.7 55.9 T-road from left. Turn left (north) on gravel road.

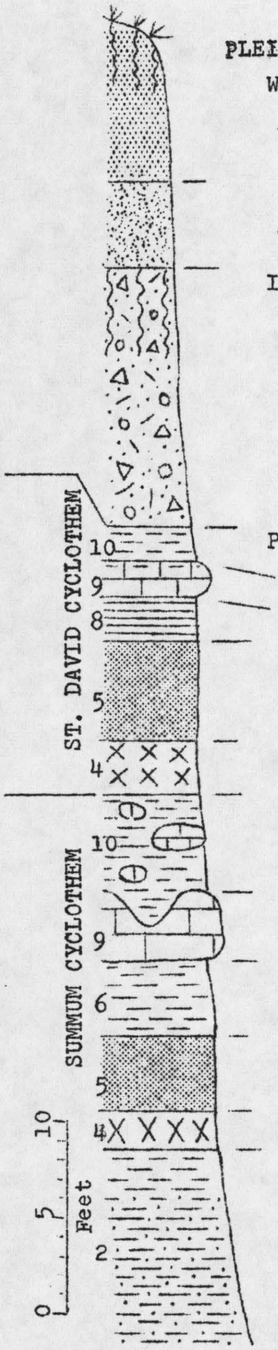
0.3 56.2 Crossroads. Jog left and then right. Continue ahead (north).

0.2 56.4 Descend into Big Creek Valley.

0.2 56.8 Stop 11. Abandoned strip mine in No. 4 and No. 5 Coals. Fossil collecting in the St. David and Hanover Limestones (NE 1/4 NE 1/4 SW 1/4, Sec. 35, T. 6 N., R. 3 E.).

This small, abandoned strip mine exposes 43 feet of the Pennsylvanian Carbondale Formation. Portions of the St. David and Summum Cyclothems can be seen. Peoria Loess, Buffalo Hart till, and the Sangamon Soil are exposed in the Pleistocene section above the bedrock (fig. 11).

The Springfield (No. 5) Coal and the Summum (No. 4) Coal, cumulatively 9 feet thick, were both mined here. The No. 4 Coal usually occurs 8 to 15 feet below the No. 5 Coal, and where thick enough, both are commonly mined at the same time. The No. 5 Coal is the most important coal in the Havana area, and it has been mined by shaft and stripping in many places.



PLEISTOCENE

WISCONSINAN

Peoria Loess, tan, finely mottled, leached with surface soil in upper half, becomes gray and tan mottled in lower half, calcareous.

Roxana Silt, chocolate brown, tan mottled, leached.

ILLINOIAN

Buffalo Hart, till, leached, with iron- and manganese-stained Sangamon Soil in upper 4.5 feet, unweathered till below soil is yellow-brown, gray mottled and highly calcareous, silty, very pebbly, with scattered igneous cobbles and boulders.

PENNSYLVANIAN

Shale (Canton), dark gray, laminated, silty, sandy, firm.

Limestone (St. David), gray, fine-grained, very fossiliferous.

Shale, black, hard, slaty, abundant flattened pelecypods in lower part.

Coal (No. 5)

Underclay, gray, carbonaceous at top, yellow streaks, soft.

Shale, dark gray at top, medium gray below, gypsiferous, laminated in upper part, blocky, sandy, and firm in lower part, contains numerous, large, dark gray, fossiliferous limestone nodules (Hanover).

Limestone (Hanover), light gray, fine-grained, nodular upper surface, highly fractured, no apparent fossils.

Shale, gray, firm, blocky, greenish in lower part.

Coal (No. 4)

Underclay, gray, firm, blocky, light gray in lower part, with small limestone nodules.

Shale, light greenish gray, weathers rusty, firm, blocky in upper part, becomes laminated downward, sandy.

Fig. 11 - Composite section of strata exposed at Stop 11. Strata above the No. 5 Coal are exposed at west end of pit; strata from the No. 5 Coal down to the Hanover Limestone are exposed in the lower level on the north side of the pit; strata below the Hanover Limestone are exposed along the south side in a ravine at the east end of the pit. Numbers indicate units of the ideal cyclothem.

The marine limestones are well-developed in the cyclothems here. The Hanover Limestone forms a solid 3-foot ledge and still exhibits the septarian structure seen at Stop 4. The upper part of the limestone consists of scattered, large nodules in the shale above the lower, massive ledge. These nodules are very fossiliferous, containing abundant brachiopods (Marginifera), but the lower, massive limestone is not. The St. David Limestone is also very fossiliferous, and excellent specimens of brachiopods, gastropods, pelecypods, bryozoa, and crinoid stems and plates can be collected. The brachiopods Marginifera, Chonetes, and the large Linoproductus are common. Unusually large crinoid stem fragments up to 1 inch in diameter are abundant. Many large blocks of St. David Limestone are scattered over the waste piles in the south side of the pit. The black, slaty shale above the No. 5 Coal contains abundant flattened pelecypods in the lower part.

There is no basal sandstone in the St. David Cyclothem, and the contact with the underlying Summum Cyclothem is conformable (not erosional). After deposition of the Hanover Limestone, the sea withdrew only far enough to permit swampy conditions to develop on the bordering Pennsylvanian lowland. The Michigan River delta did not build seaward during St. David time, and no channels were cut into the Summum strata.

COAL MINING IN FULTON COUNTY

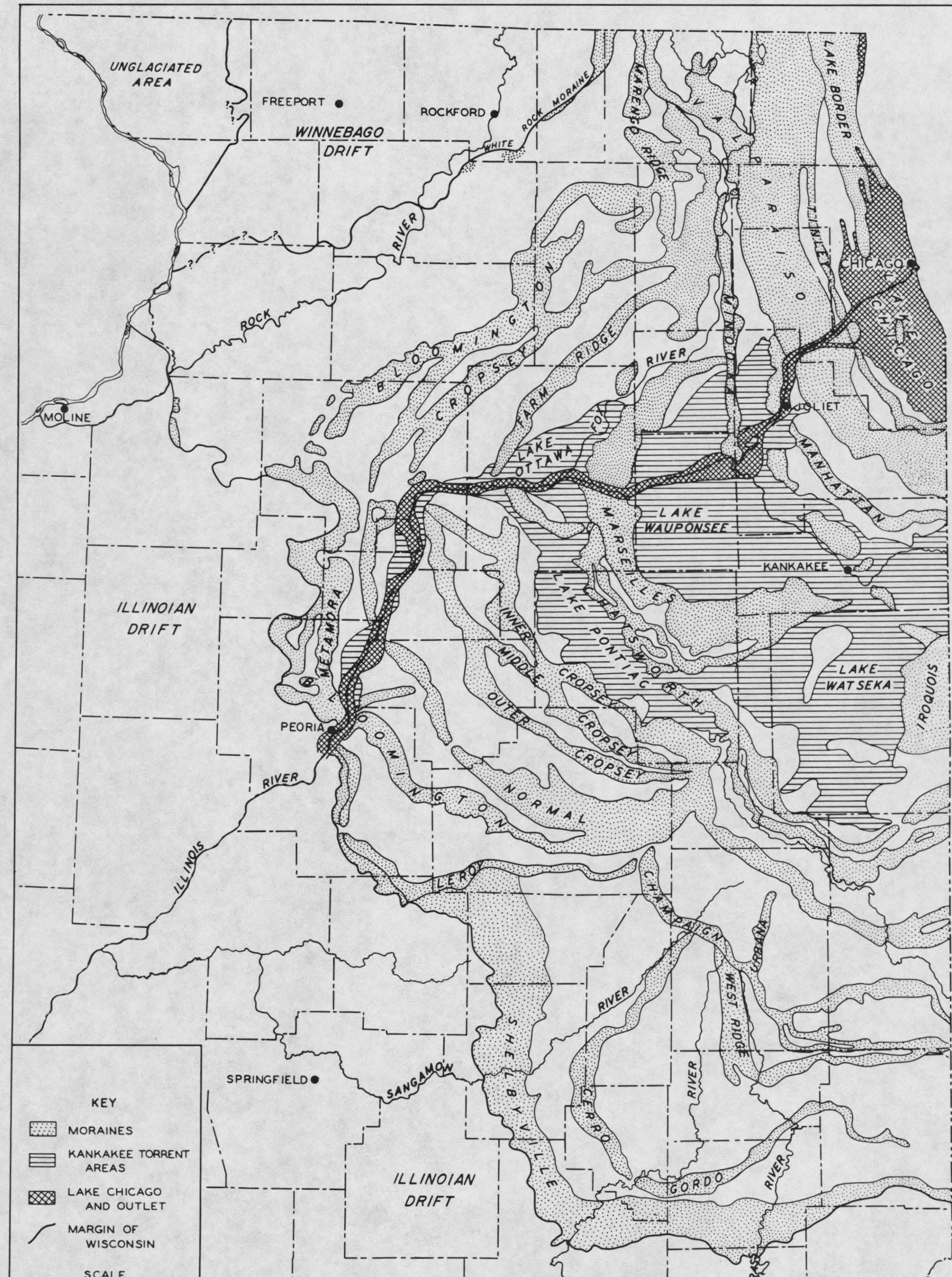
In the mid-1800's, A. H. Worthen, first director of the Illinois State Geological Survey, and his associates recognized that Fulton County showed the best developed and most complete sequence of Pennsylvanian strata and coals in the State. To them Fulton County became, essentially, the type area for studying and describing these rock units. They numbered the coals from the oldest (No. 1) to the youngest, as an aid to identifying and correlating the Pennsylvanian strata throughout Illinois. Later, however, geologists discovered by more detailed field studies that there are a few coals below Worthen's No. 1 Coal, and in addition, several coals occur between those that had been numbered previously. As a result, geographic names were assigned to all of the coals in Illinois and only the number designations of commercially important coals have been retained.

Of the 23 coal beds that have been recognized in the Havana area, most are not of commercially minable thickness. However, over half of these coals have been mined on a small scale for local use. It was not until two railroads had crossed the area shortly before the start of the Civil War that coal began to assume an important position in the area's economy. The railroads provided cheap transportation for shipment of the coal to large urban markets. From 1882, when coal production records were first made, through 1968, Fulton County has produced over 262 million tons of coal. Strip-mining in the County first began in 1924 in the vicinity of Cuba, a few miles northwest of this stop. Through 1968, strip mines in the County have yielded more than 185 million tons of coal, about 70 percent of the total production. In 1958 and in 1960, there were 21 producing strip mines in Fulton County.

Coal is the principal mineral resource exploited in the Fulton County area. Most of the reported production has come from the Springfield (No. 5), Herrin (No. 6), Colchester (No. 2), Summum (No. 4), and Rock Island (No. 1) Coals. During 1968, over 7 1/4 million tons of coal, valued at slightly less than 28.5 million dollars, were mined in the County. All of the 1968 production was from the No. 5 and No. 6 Coals from 7 strip mines that employed 951 persons.

End of Field Trip

Drive Carefully on Your Way Home

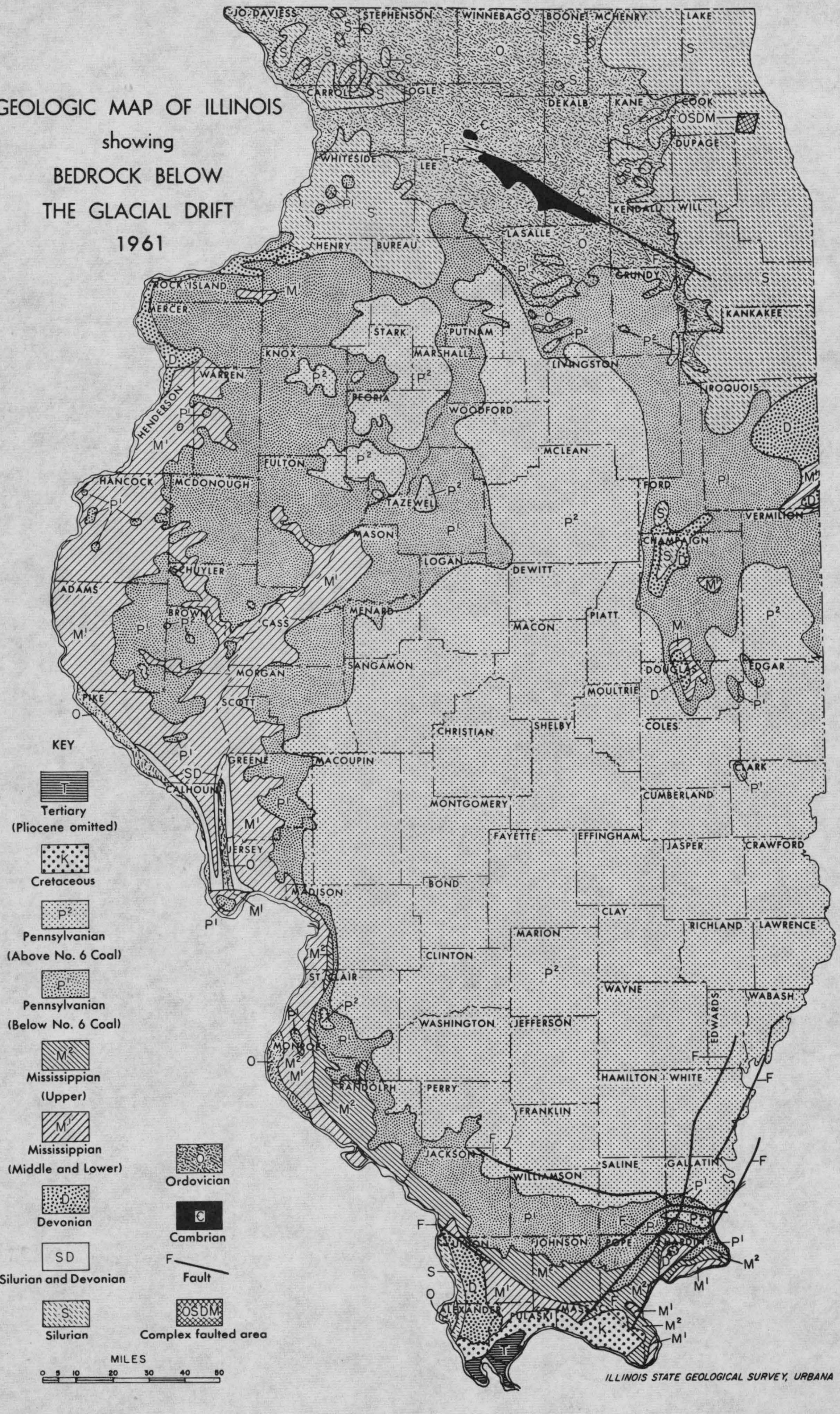


GLACIAL MAP OF NORTHEASTERN ILLINOIS

GEORGE E. EKBLAW
Revised 1960

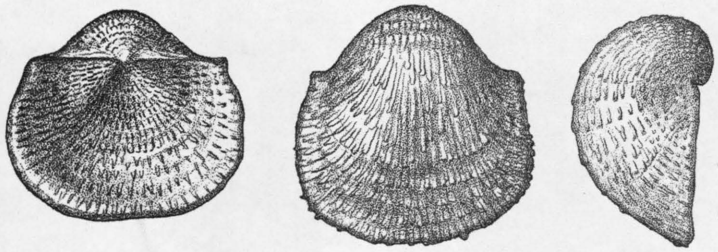
(33307—15M—10-66)

GEOLOGIC MAP OF ILLINOIS
showing
BEDROCK BELOW
THE GLACIAL DRIFT
1961

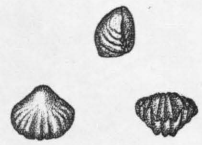


(82536—15M—11-63)

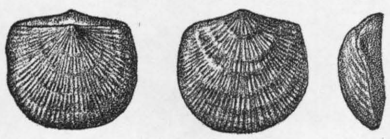
BRACHIOPODS



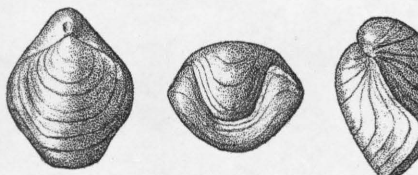
Juresania nebrascensis 2/3 x



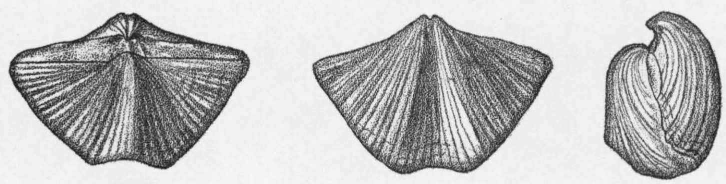
Wellerella tetrahedra 1 1/2 x



Derbya crassa 1x



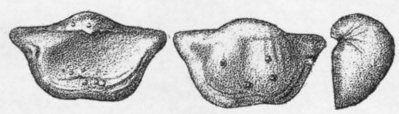
Composita argentia 1x



Neospirifer cameratus 1x

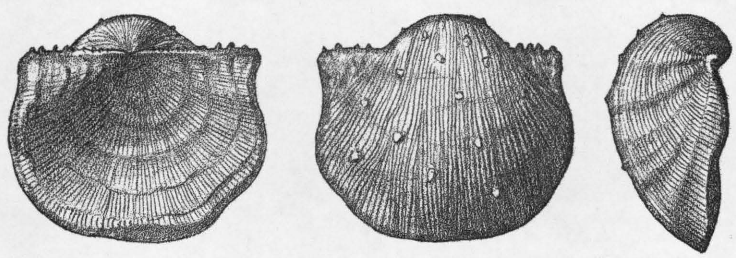
Chonetes granulifer 1 1/2 x

Mesolobus mesolobus var. *evampygus* 2x



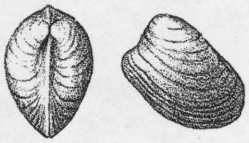
Marginifera splendens 1x

Crurithyris planoconvexa 2x



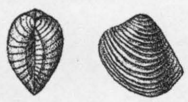
Linoproductus "cora" 1x

PELECYPODS



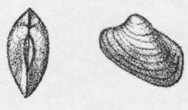
Nucula (Nuculopsis) girtyi 1x

Edmonia ovata 2x



Astartella concentrica 1x

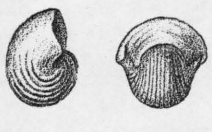
Dunbarella knighti 1½x



Cardiomorpha missouriensis "Type A" 1x

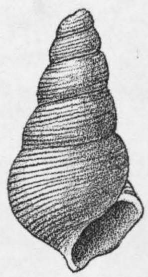
Cardiomorpha missouriensis "Type B" 1½x

GASTROPODS

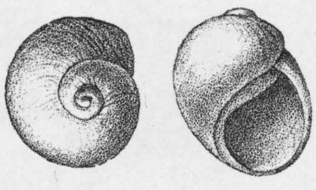


Euphemites carbonarius 1½x

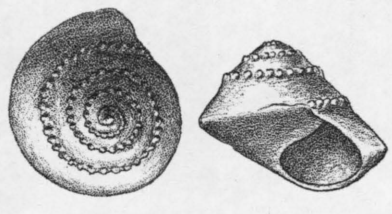
Trepospira illinoisensis 1½x



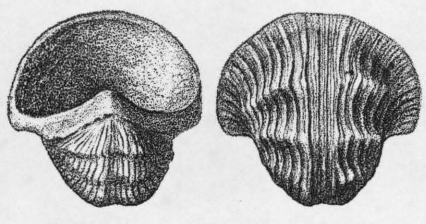
Donaldina robusta 8x



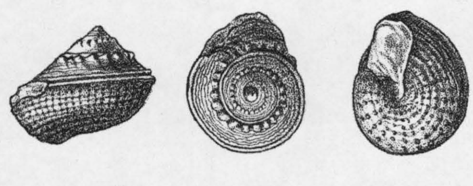
Naticopsis (Jedria) ventricosa 1½x



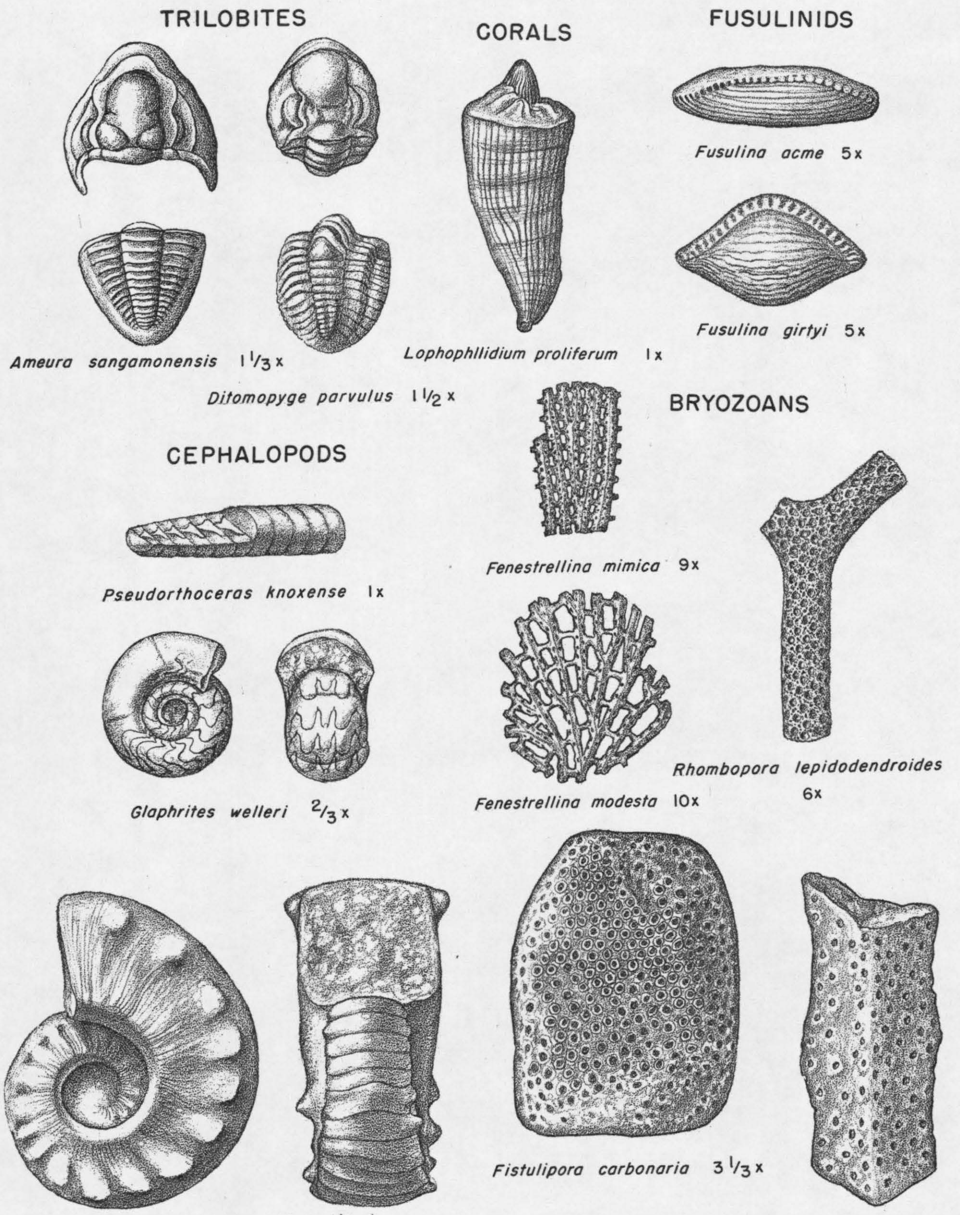
Trepospira sphaerulata 1x



Knightites montfortianus 2x



Glabrocingulum (Glabrocingulum) grayvillense 3x


TRILOBITES
CORALS
FUSULINIDS
Fusulina acme 5x
Fusulina girtyi 5x
Ameura sangamonensis 1 1/3 x
Lophophllidium proliferum 1x
Ditomopyge parvulus 1 1/2 x
BRYOZOANS
CEPHALOPODS
Fenestrellina mimica 9x
Pseudorthoceras knoxense 1x
Rhombopora lepidodendroides 6x
Glaphrites welleri 2/3 x
Fenestrellina modesta 10x
Fistulipora carbonaria 3 1/3 x
Metacoceras cornutum 1 1/2 x
Prismopora triangulata 12x

LIST OF PROPERTY OWNERS

Stop 3.

Mr. Leonard Gorsuch
R. R. 2
Astoria, Illinois 61501

Mr. Gorsuch lives in trailer just north of Stop 3.

Stop 5.

Tippey and Keeler
R. R. 3, Box 57
Lewistown, Illinois 61542

Tippey lives in the first house at the bottom of the hill on the left, south of Otto Cemetery.

Stop 6.

Mr. Carl Goudy
R. R. 3
Lewistown, Illinois 61542

Mr. Goudy lives just to the south across Route 24.

Stop 9.

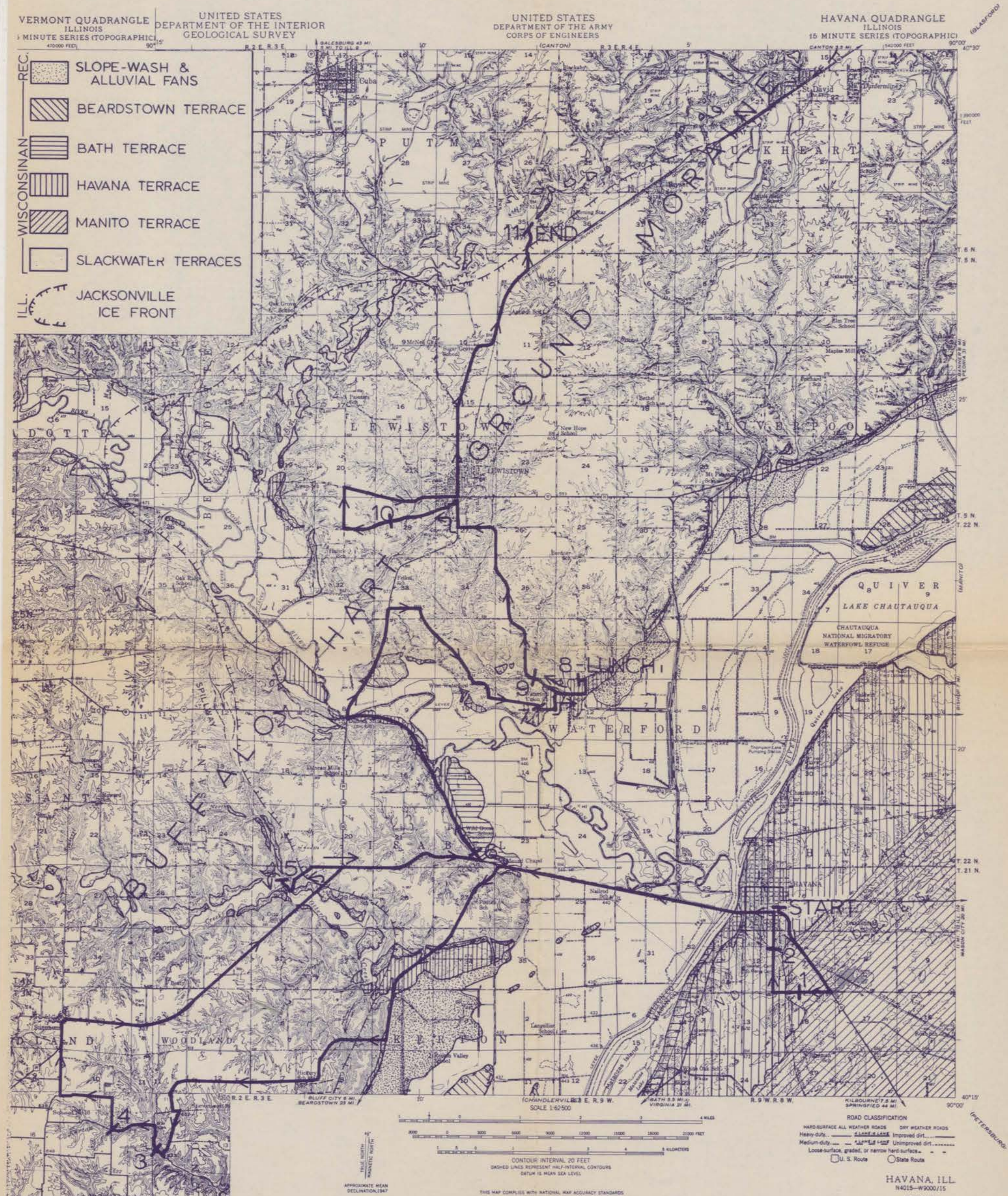
Mr. Paul Heffren
R. R. 4
Lewistown, Illinois 61542

Mr. Heffren lives at Orchard Hill Farm just east of Stop 9.

Stop 11.

Mr. Tony Benac
R. R. 1
Cuba, Illinois 61427

Mr. Benac lives in the first house on the left north of Stop 11, on the north side of Big Creek Valley.



HAVANA GEOLOGICAL SCIENCE FIELD TRIP MAY 10, 1969